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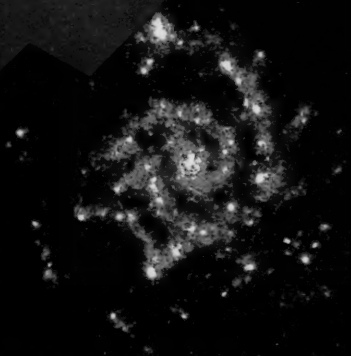

An Abstract Journal

Volume 30, Number 4
February 23, 1992
N92-12988 to N92-13925

Scientific and Technical Aerospace Reports

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Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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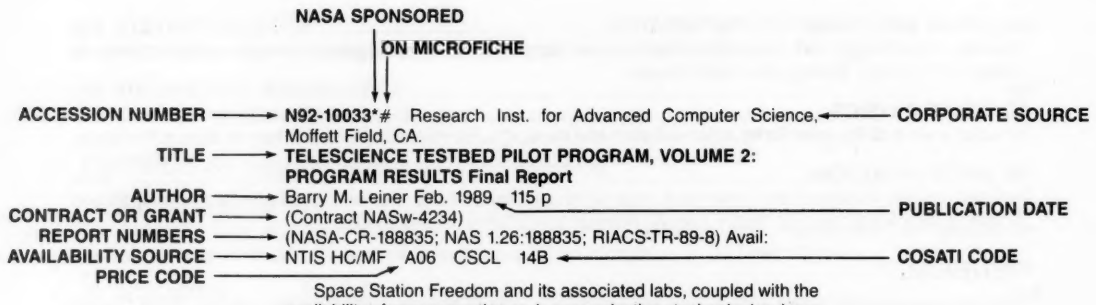

Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.

Author

VOLUME 30 NUMBER 4 / FEBRUARY 23, 1992

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N92-12988# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
A REVIEW OF UK AVIATION POLICY
Robert Caves Jul. 1991 47 p
(TT-9107; ISBN-0-904947-34-3; ETN-91-90293) Copyright
Avail: NTIS HC/MF A03

The background to present aviation policies is discussed and the U.K. (United Kingdom) aviation situation is reviewed. The main aviation issues are discussed in the light of this background. These issues come under the following headings: infrastructure capacity; role of regional airports; airport privatization; environment impact; resources; safety; security; economic regulation; EEC (Europnean Economic Community) harmonization; equal opportunity; general aviation; the civil aviation authority; aviation and the economy; integrated transport; planning methodology; policy formulation. Policy changes are suggested from a synthesis of discussions.
ESA

N92-12989*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EXPERIMENTAL STUDY OF THE SENSITIVITY OF HELICOPTER ROTOR BLADE TRACKING TO ROOT PITCH ADJUSTMENT IN HOVER
W. Keats Wilkie, Chester W. Langston, Paul H. Mirick, Jeffrey D. Singleton, Matthew L. Wilbur, and William T. Yeager, Jr. Dec. 1991 14 p
(DA Proj. 1L1-62211-A-47-AB)
(NASA-TM-4313; L-16939; NAS 1.15:4313;
AVSCOM-TR-91-B-017) Avail: NTIS HC/MF A03 CSCL 01B

The sensitivity of blade tracking in hover to variations in root pitch was examined for two rotor configurations. Tests were conducted using a four bladed articulated rotor mounted on the NASA-Army aeroelastic rotor experimental system (ARES). Two rotor configurations were tested: one consisting of a blade set with flexible fiberglass spars and one with stiffer (by a factor of five in flapwise and torsional stiffnesses) aluminum spars. Both blade sets were identical in planform and airfoil distribution and were untwisted. The two configurations were ballasted to the same Lock number so that a direct comparison of the tracking sensitivity to a gross change in blade stiffness could be made. Experimental results show no large differences between the two sets of blades in the sensitivity of the blade tracking to root pitch adjustments. However, a measurable reduction in intrack coning of the fiberglass spar blades with respect to the aluminum blades is noted at higher rotor thrust conditions.
Author

N92-12990# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
AEROSPACE KNOWLEDGE 91 (SELECTED PAGES) (PHOTO CAPTIONS)
13 Sep. 1991 11 p Transl. into ENGLISH from Hangkong Zhishi (China), no. 1, 1991
(AD-A240940; FTD-ID(RS)T-0606-91) Avail: NTIS HC/MF A03
CSCL 01/3

The Jianjiao-7P advanced fighter trainer aircraft, developed by the Guizhou Aviation Industry Corporation of the Ministry of Aviation and Space, successfully completed its first test flight on 9 Nov. 1990 at an airfield in the vicinity of Anshun, Guizhou. These photos were taken on the spot on the day of the first flight.
GRA

N92-12991# General Accounting Office, Washington, DC. National Security and International Affairs Div.
AEROSPACE PLANE TECHNOLOGY: RESEARCH AND DEVELOPMENT EFFORTS IN JAPAN AND AUSTRALIA
Oct. 1991 153 p
(AD-A241641; GAO/NSIAD-92-5) Avail: NTIS HC/MF A08
CSCL 01/3

U.S. leadership and preeminence in the research and development of aerospace plane technologies are being challenged by Japan and other countries. U.S. leadership and preeminence are based on the National Aero-Space Plane Program. As discussed in our prior report on European aerospace plane technology, congressional supporters of the program are concerned about foreign competition and its impact on U.S. technological leadership. The former Chairman of the House Committee on Science, Space, and Technology asked GAO to identify indicators to measure foreign countries' current state of aerospace plane technological development and progress. The indicators were selected based on the interests of Committee representatives and on discussions with experts. These indicators are (1) space policies and aerospace goals and objectives; (2) aerospace plane program objectives, design goals, schedules, and costs; (3) the current status and rate of progress in the development of critical technologies; (4) the funding for and the number and type of people involved with the programs; (5) test facilities and their capabilities; and (6) the existence of and interest in international cooperation. The former Chairman also asked GAO to collect data and information on the indicators.
GRA

N92-12992# Naval Postgraduate School, Monterey, CA.
IMPLEMENTING TOTAL QUALITY MANAGEMENT AT THE INTERMEDIATE LEVEL OF AIRCRAFT MAINTENANCE M.S. Thesis
Rolando C. Salvanera Dec. 1990 64 p
(AD-A241768) Avail: NTIS HC/MF A04 CSCL 05/2

This thesis will show how Total Quality Management (TQM) can be taken from theory and operationalized at the intermediate level of aircraft maintenance. It begins by presenting four factors that will support the implementation process: top level commitment in the form of CNO support; the closed loop environment of intermediate maintenance activities; the successful implementation at the depot level; and the fact that components of TQM already exist within the Navy. The thesis then introduced some of the resource centers that can assist with the implementation process. The methods of TQM implementation as advocated by Navy Resource Centers (the Navy Personnel Research and Development Center and the Naval Aviation Maintenance Office) are explored. The thesis illustrates how the use of these resource centers, the early targeting of key personnel, and the use of a pilot program can help facilitate the implementation process. An examination of the obstacles to the TQM implementation process such as adapting existing programs and reward systems, conclude the thesis.
GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-12993 Texas A&M Univ., College Station.
ESTIMATION OF STEADY AND UNSTEADY AERODYNAMIC PARAMETERS AT HIGH ANGLES OF ATTACK Ph.D. Thesis
Ming-Der Chin 1990 238 p
Avail: Univ. Microfilms Order No. DA9118205

The steady and unsteady aerodynamic parameters of the N-350 light trainer aircraft are estimated from simulated response data for angle of attack (alpha) up to 40 deg and sideslip angles (beta) to +/-15 deg. Nonlinear aerodynamic models of forces and moments are identified by applying the Estimation Before Modeling (EBM) technique to simulated flight data for high angle of attack maneuvers including stalls and post stall trajectories. For 0 deg less than or equal to beta less than or equal to 10 deg, the steady aerodynamic coefficients and significant stability and control parameters that are estimated match very well with the true values at most angles of attack, and the estimated unsteady aerodynamic parameters are in good agreement with the trend of the true model. Unsteady aerodynamics at high angles of attack are formulated using a nonlinear indicial function representation with a time lag, and simulated indicial functions related to alpha and beta are incorporated into a six degree of freedom simulation. With these indicial functions, unsteady aerodynamic effects such as hysteresis can be simulated. To check the estimation accuracy of the EBM technique and the program coding before applying this approach to the high angle of attack regime, parameters are estimated in the linear aerodynamic regime. An original approach for parameter sensitivity analysis is developred in the linear aerodynamic regime. Other novel aspects of the modified estimation technique include the use of Maximum a Posteriori (MAP) identification for smoothing/filtering flight data. States, forces, and moments are satisfactorily estimated using a forward smoother and a backward information filter based on a variational technique which minimizes the MAP cost function. Dissert. Abstr.

N92-12994*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WIND TUNNEL INVESTIGATION OF THE INTERACTION AND BREAKDOWN CHARACTERISTICS OF SLENDER WING VORTICES AT SUBSONIC, TRANSONIC, AND SUPERSONIC SPEEDS
Gary E. Erickson Washington Nov. 1991 226 p
(NASA-TP-3114; L-16803; NAS 1.60:3114) Avail: NTIS HC/MF A11 CSCL 01A

The vortex dominated aerodynamic characteristics of a generic 65 degree cropped delta wing model were studied in a wind tunnel at subsonic through supersonic speeds. The lee-side flow fields over the wing-alone configuration and the wing with leading edge extension (LEX) added were observed at M (infinity) equals 0.40 to 1.60 using a laser vapor screen technique. These results were correlated with surface streamline patterns, upper surface static pressure distributions, and six-component forces and moments. The wing-alone exhibited vortex breakdown and asymmetry of the breakdown location at the subsonic and transonic speeds. An earlier onset of vortex breakdown over the wing occurred at transonic speeds due to the interaction of the leading edge vortex with the normal shock wave. The development of a shock wave between the vortex and wing surface caused an early separation of the secondary boundary layer. With the LEX installed, wing vortex breakdown asymmetry did not occur up to the maximum angle of attack in the present test of 24 degrees. The favorable interaction of the LEX vortex with the wing flow field reduced the effects of shock waves on the wing primary and secondary vortical flows. The direct interaction of the wing and LEX vortex cores diminished with increasing Mach number. The maximum attainable vortex-induced pressure signatures were constrained by the vacuum pressure limit at the transonic and supersonic speeds. Author

N92-12995 North Carolina State Univ., Raleigh.
WALL INTERFERENCE CALCULATION IN A TRANSONIC WIND TUNNEL WITH DISCRETE SLOTS Ph.D. Thesis
Jassim Abbass Al-Saadi 1991 151 p
Avail: Univ. Microfilms Order No. DA9123341

A computational simulation of a transonic wind-tunnel test section with longitudinally slotted walls is developed. The slot model includes nonlinear slot-discreteness and dynamic-pressure effects as well as a plenum pressure constraint. The solution is performed using a finite-difference method which solves an extended transonic small disturbance equation. The walls serve as the outer boundary conditions in the relaxation technique with an interaction procedure used at the slotted walls. The technique is predictive in that measured boundary pressures are not required in establishing the wall conditions. Measured wall pressures are only used to assess the accuracy of the simulation. The method is also capable of calculating a free-air solution as well as solutions employing the classical homogeneous wall conditions. Wall interference effects are determined by comparing test-section and free-air calculations. The simulation is used to examine two commercial transport aircraft models at both zero-lift and cruise conditions. Although the plenum pressure has a significant effect on the solution, little effect of slot discreteness if found with the models currently considered. At cruise conditions the wall interference results in errors on the order of one percent in the lift, drag, and pitching moment. The three-dimensional nature of the interference is shown by examining the wing pressure distributions. The walls induce an error in the position of the wing shock wave which is found to vary along the wing. It is concluded that the traditional concept of wall-interference corrections to Mach number and angle of attack may not be suitable for transonic conditions. Dissert. Abstr.

N92-12996# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
VORTEX FLOW AERODYNAMICS
Jul. 1991 537 p In ENGLISH and FRENCH Symposium held in Scheveningen, Netherlands, 1-4 Oct. 1990
(AGARD-CP-494; ISBN-92-835-0623-5) Copyright Avail: NTIS HC/MF A23; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The AGARD Fluid Dynamics Panel sponsored this symposium to provide an update review of the aerodynamic effects of separation-induced vortex flows on the design and off-design performance of fighter aircraft. A better understanding is needed to predict and control these vortex flows throughout the flight envelope at subsonic, transonic, and supersonic speeds, and especially during high lift operations for take-offs, landings, and sustained and instantaneous maneuvers. Topics of interest included vortex development and burst, modeling and validation of the full range of analytic methods, slender-body vortex flows at high angles of attack, vortex control and management, and unsteady vortex flow effects. In addition to the symposium papers, the results of the round table discussion are presented. For individual titles, see N92-12997 through N92-13028.

N92-12997# National Aerospace Lab., Amsterdam (Netherlands).
MODELING AND NUMERICAL SIMULATION OF VORTEX FLOW IN AERODYNAMICS
H. W. M. Hoeijmakers *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 46 p Sponsored in part by the Netherlands Agency for Aerospace Programs (NIVR) for the Netherlands Ministry of Defence (For primary document see N92-12996 04-02)
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A review is presented of mathematical models of different levels of approximation and their application to the numerical simulation of vortical flows occurring in subsonic and transonic aircraft aerodynamics. Computational methods for predicting the

downstream development of vortex wakes are covered as well as methods for simulating the detailed characteristics of configurations with leading-edge or body vortices.The emphasis is on the later, strong-interaction type of vortical flows. Promising developments related to presently used methods are discussed in some detail. The possibilities, limitations, and prospects for improving the methods are indicated and results of various methods are discussed. Also considered are some more fundamental aspects of the numerical simulation of phenomena such as separation at sharp and round leading edges, separation at a smooth part of a surface, the structure of the leading-edge vortex, and the merging of two vortices. Author

N92-12998# Royal Aircraft Establishment, Farnborough (England).
COMPARISON OF SOLUTION OF VARIOUS EULER SOLVERS AND ONE NAVIER-STOKES SOLVER FOR THE FLOW ABOUT A SHARP-EDGED CROPPED DELTA WING
B. R. Williams, W. Kordulla, M. Borsi, and H. W. M. Hoeijmakers *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 12 p Previously announced as N91-30106 Sponsored in part by the Ministry of Defence, England; German Ministry of Defence; Italian Ministry of Defence; and the Netherlands Agency for Aerospace Programs for the Ministry of Defence (For primary document see N92-12996 04-02)
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For the flow about a sharp-edged cropped 65-deg delta wing numerical solutions obtained with different Euler methods are compared with each other, with the numerical solution of a Reynolds-averaged Navier-Stokes method, and with experimental data. At the selected free-stream Mach number of 0.85 and angle of attack of 10 deg the flow features a leading-edge vortex, is transonic, but contains weak shocks only. The results of the Euler methods have been obtained on one and the same C-H type of grid with close to 300,000 cells. This investigation, carried out within the framework of a four-nation collaborative program, indicates that for the test case considered there are, from a theoretical point of view, significant differences between results from different Euler methods, even if artificial dissipation is minimized. However, the correlation of the Euler solutions with experimental data shows much larger differences due to the failure to represent secondary separation in the Euler methods and is therefore unsatisfactory. The results of the Reynolds-averaged Navier-Stokes method demonstrate an improved correlation of theory and experiment. Author

N92-12999# Aeritalia S.p.A., Turin (Italy).
VORTICAL FLOW SIMULATION BY USING STRUCTURED AND UNSTRUCTURED GRIDS
M. Borsi, L. Formaggia, E. Hettena, S. Santillan, V. Selmin, and S. Tarditi *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 12 p Previously announced as N91-30107 (For primary document see N92-12996 04-02)
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Two Euler equation solvers based on finite volume formulations on structured and unstructured grids are applied to the simulation of transonic vortical flow around a delta wing-body configuration. The mesh generation techniques are described, some details on the flow solvers are given, and a comparison between the methods is presented. Author

N92-13000# National Aerospace Lab., Amsterdam (Netherlands).
ANALYSIS OF RESULTS OF AN EULER-EQUATION METHOD APPLIED TO LEADING-EDGE VORTEX FLOW
J. I. vandenBerg, H. W. M. Hoeijmakers, and J. M. J. W. Jacobs *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 12 p Sponsored in part by the Netherlands Agency for Aerospace Programs (NIVR) for the Netherlands Ministry of Defence (For primary document see N92-12996 04-02)
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The flow about a 65-deg sharp-edged cropped delta wing with and without an under-wing body is simulated by solving the Euler equations. Results are presented for the wing-body configuration at a transonic free-stream Mach number at incidences ranging from 10 to 20 deg for which in the flow field above the wing a strong vortex develops as well as shocks for the high incidence of 20 deg. Results for subsonic to transonic free-stream Mach numbers at high incidence are obtained for the wing-alone configuration for which in the presence of a strong vortex, at transonic free-stream Mach number, shocks appear in the solution. For the wing-body configuration, the computational results are compared with experimental data, and the solution in the near wake is investigated. Author

N92-13001# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
EXPERIMENTAL AND NUMERICAL INVESTIGATION OF THE VORTEX FLOW OVER A DELTA WING AT TRANSONIC SPEED
E. M. Houtman and W. J. Bannink *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 11 p (For primary document see N92-12996 04-02)
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The flow around a sharp-edged delta wing with 65-deg sweep and a flat upper surface was investigated experimentally as well as numerically. The experimental program consisted of surface pressure measurements, oil flow visualization, and flow field explorations at Mach numbers 0.60 and 0.85 and angles of attack up to 20 deg. The results show a transonic leeward flow structure with several shock waves. At a Mach number of 0.85 and 20 deg angle of attack vortex breakdown is observed. The vortex breakdown goes along with a double shock system in the symmetry plane region. In the numerical program a 3D Euler code is used with two upwind schemes; one of the flux-splitting type and one of the flux-difference-splitting type. The results show significant differences between the two discretization schemes, in particular in the region of the vortex. Between computations and experiments large differences are observed due to the absence of secondary separation, and, at the higher angles of attack, due to the absence of vortex breakdown in the computations. Author

N92-13002*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RECENT PROGRESS IN COMPUTATIONAL VORTEX-FLOW AERODYNAMICS
James M. Luckring *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 21 p (For primary document see N92-12996 04-02)
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Recent progress in computational vortex flow aerodynamics at the Langley Research Center is reviewed. Emphasis is placed on Navier-Stokes methodology, both for compressible and incompressible flows, and results are presented from central and upwind-biased schemes for fully laminar, transitional, and fully turbulent flows. In addition, results are presented from selected potential-based methods to address the hierarchy of formulations presently available for the computational analysis of aerodynamic vortex flows. Some comparisons among this hierarchy of methods are shown. Author

N92-13003# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
ON THE SIMULATION OF COMPRESSIBLE TURBULENT FLOWS PAST DELTA WING, DELTA WING-BODY AND DELTA WING-CANARD
Achim Hilgenstock and Heinrich Vollmers *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 13 p (For primary document see N92-12996 04-02)

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The turbulent flow around a delta wing at incidence is simulated numerically using a finite volume Navier-Stokes method. The numerical simulation makes use of a simple algebraic turbulence model. Using a sharp leading edge delta wing, the influence of grid refinement is investigated. A realistic wing-body configuration with a round leading edge is used to discuss the influence of the position of the transition line. Experimental and numerical data are compared to validate the numerical method. The topological structure of the flow is discussed. An explanation is given for the low particle density area close to the primary vortex as it is visualized by the laser light sheet technique. First results for a closed coupled delta-wing-canard configuration are also discussed. Author

N92-13004# Aeronautical Research Inst. of Sweden, Bromma.
CALCULATION OF HYPERSONIC LEESIDE VORTICES OVER BLUNT DELTA WINGS
Arthur Rizzi, Earll M. Murman, Peter Eliasson, and Kuok-Ming Lee (Massachusetts Inst. of Tech., Cambridge.) *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 17 p (For primary document see N92-12996 04-02)
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Hypersonic vortical flow on the leeside of a blunt delta wing using both the Euler equations and the Navier-Stokes equations with two different and independent numerical methods in order to evaluate the inviscid and viscous mechanisms of leeside vortex formation is investigated. Comparisons of results from the same method as well as comparisons of results from the two different methods are the focal point of this work. The intent is to reach a reasonable understanding of the computed flow structures, including flow separation, shear layers, vortices, shock waves, and entropy losses. It was found that instead of the concentrated vortex usually found over a delta wing in transonic speed, the flow in hypersonic speed is dominated by a shear layer that separates just past the blunt leading edge and forms a more distributed vortical region over the wing. Windside features like the bow shock agree well in all the numerical solutions. But there are substantial discrepancies in the prediction of the Stanton number on the wing surface. Author

N92-13005# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
ON THE FOOTPRINTS OF THREE-DIMENSIONAL SEPARATED VORTEX FLOWS AROUND BLUNT BODIES: ATTEMPTS OF DEFINING AND ANALYZING COMPLEX FLOW STRUCTURES
Uwe Dallmann, Achim Hilgenstock, Stefan Riedelbauch, Burkhard Schulte-Werning, and Heinrich Vollmers *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 13 p (For primary document see N92-12996 04-02)
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An analysis of vortex flows around different configurations in very different Mach and Reynolds regimes is presented. Subsonic, transonic, and hypersonic separated flows are considered. The common interest was to study the relationships between the topologies of steady or unsteady, two dimensional or three dimensional separated vortex flow structures and their footprints which they leave on the boundaries (walls) or within any section across the flow field. From this point of view numerical Navier Stokes simulations are analyzed in the following respect: Topological changes of the instantaneous sectional streamlines and the skin friction patterns of incompressible flows are considered during vortex shedding and during onset of three dimensionality of the flow. Two dimensional separation bubbles, separation from a cylinder in crossflow, and separation from a sphere are analyzed. The formation of vortex cores and their relationship to so called open or closed flow separation, wall vorticity, wall pressure, wall heat flux, and various sectional flow data are investigated in compressible flows such as the transonic transitional flow around a round edged delta wing and the hypersonic laminar flow around a double ellipsoid. Author

N92-13006# East Anglia Univ., Norwich (England). School of Mathematics.
LAMINAR-FLOW SECONDARY SEPARATION ON A SLENDER WING
K. Kirkkopru and N. Riley *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 10 p (For primary document see N92-12996 04-02)
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High Reynolds number laminar flow of an incompressible fluid past a slender delta wing at incidence is considered. An interactive viscous inviscid calculation is carried out to determine the secondary separation flow properties on the wing. The overall interactive procedure includes a modification to the leading edge vortex sheet configuration which represents the primary separation. Encouraging comparisons are made with experiment. Author

N92-13007*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NONEQUILIBRIUM TURBULENCE MODELING EFFECTS ON TRANSONIC VORTICAL FLOWS ABOUT DELTA WINGS
Unver Kaynak, Eugene Tu, Mustafa Dindar, and Remzi Barlas (Turkish Aerospace Industries, Ankara.) *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 13 p Sponsored in part by NASA (For primary document see N92-12996 04-02)
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The Johnson-King turbulence model that is a viable method for calculating two dimensional transonic separated flows was extended into three dimensions. The implementation was done for Navier Stokes flow solvers written in general curvilinear coordinates. The present approach used in turbulence modeling is based on streamwise integration of an ordinary differential equation (o.d.e.) that governs the maximum Reynolds shear stress behavior. Streamwise integration of the o.d.e. approach was found to offer great mathematical simplicity and economy for three dimensional Navier Stokes methods. Thus, the new method is quick, simple, and very cheap. The new method was first checked against the data of a well known transonic axisymmetric bump experiment, and a good agreement was obtained. Later, the new method was used to compute the flow around a low aspect ratio wing in a transonic wind tunnel. Finally it was employed to study the nonequilibrium turbulence effects on the transonic vortical flows about a 65 deg sweep round leading edge delta wing. Author

N92-13008# Royal Aircraft Establishment, Farnborough (England).
REVIEW OF AIRCRAFT DYNAMIC LOADS DUE TO FLOW SEPARATION
D. G. Mabey *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 10 p (For primary document see N92-12996 04-02)
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A detailed review of the 70th meeting of the Advisory Group for Aerospace Research and Development (AGARD) Structures and Materials Panel, prepared for the AGARD Fluid Dynamics Panel, is presented. Accordingly emphasis is placed on the aerodynamic information presented, rather than the structural aspects. Experimental results and computations are described for flows with bubble and vortex separations. Some conclusions are drawn and recommendations are made for further research. In particular, the review suggests that much greater attention should be given to establishing the magnitude of possible scale effects (both in experiments and calculations) and to the prediction of fin buffeting. Author

N92-13009*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
IN-FLIGHT FLOW VISUALIZATION AND PRESSURE MEASUREMENTS AT LOW SPEEDS ON THE NASA F-18 HIGH ALPHA RESEARCH VEHICLE

John H. DelFrate, David F. Fisher, and Fanny A. Zuniga *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 42 p Previously announced as N90-28505 (For primary document see N92-12996 04-02)
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Inflight results from surface and off surface flow visualizations and from extensive pressure distributions document the vortical flow on the leading edge extensions (LEXs) and forebody of the NASA F-18 high alpha research vehicle (HARV) for low speeds and angles of attack up to 50 deg. Surface flow visualization data, obtained using the emitted fluid technique, were used to define separation lines and laminar separation bubbles (LSB). Off surface flow visualization data, obtained by smoke injection, were used to document both the path of the vortex cores and the location of vortex core breakdown. The location of vortex core breakdown correlated well with the loss of suction pressure on the LEX and with the flow visualization results from ground facilities. Surface flow separation lines on the LEX and forebody corresponded well with the end of pressure recovery under the vortical flows. Correlation of the pressures with wind tunnel results show fair to good correlation. Author

N92-13010# Technische Univ., Brunswick (Germany, F.R.).
VORTEX FORMATION OVER A CLOSE-COUPLED CANARD-WING-BODY CONFIGURATION IN UNSYMMETRICAL FLOW
A. Bergmann, D. Hummel, and H.-Chr. Oelker (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 14 p (For primary document see N92-12996 04-02)
(Contract DFG-Hu-254/8)
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A close coupled canard wing body combination was investigated in unsymmetrical flow. The configuration consisted of a delta canard, a delta wing, and a body of revolution as the fuselage. Six component and surface pressure distribution measurements as well as flow visualizations by means of the laser lightsheet technique were carried out at Reynolds numbers (based on wing inner chord) of Re = 1.1 x 10(exp 6) and Re = 1.4 x 10(exp 6) for the canard-off and the canard-on configuration. For large angles of attack distinct jumps of the aerodynamic coefficients have been detected in unsymmetrical flow which are due to sudden changes of the flow structure. In the canard-off configuration they are caused by the collapse of the vortex type flow on the windward side of the configuration into a deadwater type flow which takes place when the vortex breakdown position within the wing vortices reaches the wing apex. In the canard-on configuration the sensitive and favorable interference between canard and wing is suddenly disturbed. Apart from a small region in the vicinity of the symmetrical flow in which a vortical flow at the canard can be maintained up to extremely large angles of attack, in unsymmetrical flow at high angles of attack the flow over the windward side of the canard collapses from a vortex type flow to a deadwater type flow due to a sudden loss of favorable interference, and this causes the jumps in the slope of the aerodynamic coefficients. Author

N92-13011# National Aerospace Lab., Amsterdam (Netherlands).
AN EXPERIMENTAL STUDY OF THE FLOW OVER A SHARP-EDGED DELTA WING AT SUBSONIC AND TRANSONIC SPEEDS
A. Elsenaar and H. W. M. Hoeijmakers *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 19 p Sponsored in part by the Netherlands Agency for Aerospace Program (NIVR) for the Netherlands Ministry of Defence (For primary document see N92-12996 04-02)
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The flow about a sharp edged cropped delta wing is investigated experimentally. The experiment comprised detailed surface pressure measurements at low subsonic, transonic, and low supersonic freestream Mach numbers for angles of attack up to 27 deg. The major part of the measurements were carried out at a Reynolds number of 9 million, but some data was also obtained at lower and higher Reynolds numbers. The investigation included continuous schlieren flow field visualization as well as surface flow visualizations at a limited number of free stream conditions. The analysis of the measured data embraced flow field phenomena such as primary separation and the formation of the leading edge vortex, secondary separation and the formation of the secondary vortex, shock waves, and the onset of vortex breakdown. Considered are the influence of Mach number, incidence, and Reynolds number on these flow features. Author

N92-13012# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Aerothermodynamique.
CHARACTERISTICS OF A BOUNDARY LAYER IN A LEADING EDGE VORTEX [CARACTERISTIQUES D'UNE COUCHE LIMITE EN AVAL D'UN TOURBILLON DE BORD D'ATTAQUE]
G. Pailhas and J. Cousteix *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 17 p In FRENCH; ENGLISH summary (For primary document see N92-12996 04-02)
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The boundary layer developing downstream of a leading edge vortex was investigated. This experiment is devoted to the understanding of the behavior of such a boundary layer submitted to the effects of a leading edge vortex developing on the suction side of a swept wing. The infinite swept wing considered for the present study is mounted between the top and the bottom walls of the test section at a sweep angle of 60 degrees and at an incidence of 15 degrees. The airfoil is symmetric and has a maximum thickness ratio of .1 and a chord length of 200 mm; it is an ONERA D airfoil, that is, a peaky-type airfoil. Mean and turbulent velocity profile surveys were carried out in various positions located downstream of the reattachment line, but also for a few positions in the vortex core by means of hot wire anemometry. Measurements in the vortex core and in the boundary layer were made by using respectively a four and single hot wire probe. Author

N92-13013# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
VORTEX FLOW ON A MISSILE BODY: EXPERIMENTAL STUDY AND MODELING [ECOULEMENT TOURBILLONNAIRE SUR FUSELAGE DE MISSILE ETUDE EXPERIMENTALE ET MODELISATION]
P. Champigny and D. Baudin *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 9 p In FRENCH; ENGLISH summary Previously announced in IAA as A91-16738 (For primary document see N92-12996 04-02)
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The vortex flowfield around a missile body was investigated in the ONERA S2MA wind tunnel in order to predict missile aerodynamic characteristics. For angles of attack up to 20 degrees and Mach numbers ranging from 0.8 to 3.0, five-hole probe measurements give the local characteristics of the flow, e.g., transverse velocity vectors, local Mach numbers, and stagnation pressures. The position, strength, and core radius of the vortices are analyzed and a modeling of the flowfield based on viscous vortices is described. Applications of this model to missile aerodynamics show the need to take the nose vortices into account in engineering methods for good performance predictions.
Author

N92-13014# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
ASYMMETRIC VORTEX FLOW OVER CIRCULAR CONES
M. Pidd and J. H. B. Smith *In* AGARD, Vortex Flow Aerodynamics

Jul. 1991 11 p (For primary document see N92-12996 04-02)
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Presented here is an update on earlier Royal Aerospace Establishment (RAE) work on the formation of asymmetric vortices from slender pointed bodies at large angles of incidence. The emphasis is on theoretical and experimental work on flow over circular cones. For a single line vortex model of asymmetric conical flow over circular cones with symmetric separation lines, a thorough exploration of parameter space revealed only insignificant regions of multiple solutions and no further bifurcation locus from which asymmetric solutions could arise. An examination of the stability of solutions of this model to small spatial disturbances has shown that stable symmetric solutions are confined to a narrow band of values of the incidence parameter, but that, with insignificant exceptions, the asymmetric solutions are stable. An examination of low speed experimental data shows that asymmetric flow over a circular cone can be significantly non-conical with large variations in local side force coefficient along the length of the cone. At an angle of incidence of 35 degrees on a 10 degree cone, the approximately conical flows appear to predominate, but at 30 degrees they only occur exceptionally. Author

N92-13015# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF FINENESS RATIO ON LATERAL FORCE ON A POINTED SLENDER BODY OF REVOLUTION
I. R. M. Moir *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 13 p (For primary document see N92-12996 04-02)
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Tests were made on a slender body model in the Royal Aerospace Establishment (RAE) Farnborough 5 meter pressurized low speed wind tunnel. Measurements of side force variation with angle of incidence and with roll angle are presented, together with an examination of the angle of incidence at which side force onset occurs and how this varies with nose apex angle, overall fineness ratio, and Reynolds number. A flow visualization technique was used to study the development of vortical symmetry as angle of incidence was increased. Author

N92-13016# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
PHYSICS OF VORTICAL FLOW [PHYSIQUE DES ECOULEMENTS TOURBILLONNAIRES]
J. Delery *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 32 p In FRENCH, ENGLISH summary (For primary document see N92-12996 04-02)
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In three dimensional flows, separation leads to the formation of vortical structures resulting from the rolling up of a sheet of viscous flow, initially contained in a thin boundary layer, which springs out from the obstacle surface into the outer perfect fluid flow. A clear physical understanding of this phenomenon must rely on a rational analysis of the flowfield, calling upon the critical points theory. With this theory, it is possible to correctly interpret the surface flow patterns which constitute the imprints of the outer flow and to give a rational description of the vortical system. This kind of analysis is applied to separated flows generated by typical bodies, the field of which has been carefully investigated by means of visualizations and surveys using multi-hole probes and laser velocimetry. The problem of vortex breakdown, so important for a large number of applications, is discussed briefly. Author

N92-13017*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
BREAKING DOWN THE DELTA WING VORTEX: THE ROLE OF VORTICITY IN THE BREAKDOWN PROCESS
R. C. Nelson and Kenneth Dale Visser *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 15 p Sponsored in part by Notre Dame Univ. (For primary document see N92-12996 04-02)
(Grant NAG1-1156)
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Experimental x-wire measurements of the flowfield above a 70 degree and 75 degree flat plate delta wing were performed at a Reynolds number of 250,000. Grids were taken normal to the wing at various chordwise locations for angles of attack of 20 degrees and 30 degrees. Axial and azimuthal vorticity distributions were derived from the velocity fields. The dependence of circulation on distance from the vortex core and on chordwise location was also examined. The effects of nondimensionalization in comparison with other experimental data is made. The results indicate that the circulation distribution scales with the local semispan and grows in a nearly linear fashion in the chordwise direction. The spanwise distribution of axial vorticity is severely altered through the breakdown region and the amount of vorticity present appears to reach a maximum immediately preceding breakdown. The axial velocity components with a negative sense, such as that found in the secondary vortex, seem to remain unaffected by changes in wing sweep or angle of attack, in direct contrast to the visible components. In addition, the inclusion of the local wing geometry into a previously derived correlation parameter allows the circulation of growing leading edge vortex flows to be reduced to a single curve. Author

N92-13018# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
DETERMINATION OF VORTEX-BREAKDOWN CRITERIA BY SOLVING THE EULER AND NAVIER-STOKES EQUATIONS [DETERMINATION DE CRITERES D'ECLATEMENT TOURBILLONNAIRE PAR RESOLUTION DES EQUATIONS D'EULER ET DE NAVIER STOKES]
T. H. Le, Ph. Mege, and Y. Morchoisne *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 10 p In FRENCH; ENGLISH summary Previously announced in IAA as A91-26081 (For primary document see N92-12996 04-02)
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A parametric study based on numerical simulations which solve Euler and Navier-Stokes equations is performed on the configuration of an isolated vortex subjected to an initial perturbation. An analysis of the vortex breakdown characteristics indicates that the phenomenon appears abruptly, that it is three dimensional and unsteady by nature, and that the turbulence is characterized by small-scale structures that are established at a specified moment. This analysis permits a criterion to be specified that is based on an appropriately defined local Rossby number to determine the area where breakdown occurs. Author

N92-13019*# McDonnell Aircraft Co., Saint Louis, MO. Aerodynamics Dept.
INVESTIGATION OF VORTEX BREAKDOWN ON A DELTA WING USING EULER AND NAVIER-STOKES EQUATIONS
S. Agrawal, R. M. Barnett, and B. A. Robinson *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 12 p (For primary document see N92-12996 04-02)
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A numerical investigation of leading edge vortex breakdown in a delta wing at high angles of attack is presented. The analysis was restricted to low speed flows on a flat plate wing with sharp leading edges. Both Euler and Navier-Stokes equations were used and the results were compared with experimental data. Predictions of vortex breakdown progression with angle of attack with both Euler and Navier-Stokes equations are shown to be consistent with the experimental data. However, the Navier-Stokes predictions show significant improvements in breakdown location at angles of attack where the vortex breakdown approaches the wing apex. The predicted trajectories of the primary vortex are in very good agreement with the test data, the laminar solutions providing the overall best comparison. The Euler shows a small displacement

of the primary vortex, relative to experiment, due to the lack of secondary vortices. The turbulent Navier-Stokes, in general, fall between the Euler and laminar solutions. Author

N92-13020*# Vigyan Research Associates, Inc., Hampton, VA.
VORTEX CONTROL: FURTHER ENCOUNTERS
Dhanvada M. Rao *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 12 p Sponsored in part by NASA. Langley Research Center; and by AF (For primary document see N92-12996 04-02)
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The progress of continuing investigations on vortex control techniques is updated. The following topics are briefly discussed: (1) vortex flaps adapted for high-alpha control; (2) alleviation of leading edge extension (LEX) vortex induced twin-tail buffet; (3) controlled decoupling of interactive forebody chine and wing vortices; (4) forebody vortex manipulation by mechanical and pneumatic techniques; and (5) stall-departure alleviation of high aspect-ratio wings. Salient results of exploratory low speed wind tunned experiments are presented. The investigations, primarily aimed at concept validation, were performed on generic configurations utilizing flow visualizations and pressure and balance measurements. Selected results illustrate the efficacy and potential for development of specific vortex control concepts for improved high-alpha configuration aerodynamics. Author

N92-13021# Technische Univ., Aachen (Germany, F.R.). Dept. of Aerospace Engineering.
ON AIRCRAFT WAKE PROPERTIES AND SOME METHODS FOR STIMULATING DECAY AND BREAKDOWN OF TIP VORTICES
R. Staufenbiel and T. Vitting *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 14 p Sponsored in part by Deutsche Forschungsgemeinschaft (DFG) (For primary document see N92-12996 04-02)
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Investigations on the formation and structure of wing tip vortices are presented. A computational method for the time-dependent roll-up process is derived, which is based on the Biot-Savart approach with a particular technique of amalgamation which preserves energy, center of vorticity, and the second moment of vorticity distribution. The results are compared with laser Doppler velocimeter (LDV) measurements performed in a water tunnel. The influence of lift distribution on maximum circumferential velocity of trailing vortices is investigated. Moreover, some special devices for vortex wake alleviation were experimentally investigated in order to reveal the potential of three methods for vortex wake alleviation: (1) artificially destabilizing the vortex; (2) inducing breakdown of the vortex core; and (3) spreading and splitting the vorticity of trailing vortices. Author

N92-13022# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
CONTROL OF FOREBODY VORTICES BY SUCTION AT THE NOSE OF THE RAE HIGH INCIDENCE RESEARCH MODEL
A. Jean Ross and E. B. Jefferies *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 9 p (For primary document see N92-12996 04-02)
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The concept of applying suction at the nose of forebodies at high angle of attack to control the vortex flow was applied in static and dynamic wind tunnel tests on the RAE High Incidence Research Model. The first series of static tests showed that sideforce and yawing moment varied nearly linearly with the flow rate (or mass flow) coefficient, rather than the momentum coefficient, up to a maximum, but the maximum control powers available were small on the original drooped forebody. The results for suction on a large ogival forebody give yawing moment equivalent to about 25 degrees of rudder at an angle of attack of 30 degrees, and significantly higher for higher angles. They also show some dependence on whether separation is laminar or turbulent, and parameters defining the variation with flow rates are compared. Dynamic experiments on a free-to-yaw rig, with active control of flow rates, were inconclusive and further experiments are being conducted. Author

N92-13023# Royal Aircraft Establishment, Farnborough (England).
AN EXPERIMENTAL INVESTIGATION OF VORTEX FLAPS ON A CANARD COMBAT-AIRCRAFT CONFIGURATION
D. A. Lovell *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 11 p (For primary document see N92-12996 04-02)
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A low-speed wind tunnel investigation of two vortex-flap configurations fitted to a canard-delta combat-aircraft research model having a 53 degree sweep wing is reported. The effect of foreplane interference and vortex-flap geometry on the aerodynamic performance of the vortex flaps is determined. It is concluded that vortex flaps can generate large gains in trimmed lift and lift to drag ratio, particularly when used in conjunction with trailing-edge flaps. Author

N92-13024# General Dynamics Corp., Fort Worth, TX.
STEADY AND UNSTEADY AERODYNAMICS OF A PITCHING STRAKED WING MODEL AT HIGH ANGLES OF ATTACK
A. M. Cunningham, Jr. and R. G. denBoer (National Aerospace Lab., Amsterdam, Netherlands) *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 10 p (For primary document see N92-12996 04-02)
Copyright Avail: NTIS HC/MF A23; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Results are presented and discussed for the low speed test of a straked wing model oscillating in pitch that was conducted during 1986 at the National Aerospace Laboratory of the Netherlands. The model was oscillated about mean angles of attack ranging from -4 to 48 degrees with amplitudes varying from 2 to 18 degrees for a maximum incidence range of -8 to 50 degrees. It was also oscillated in pitch at side slip angles of 5 and -5 degrees. Force, pressure, and flow visualization data were recorded, processed, and documented in log magnetic tapes. A description of the model, test programs, steady aerodynamic characteristics, and unsteady aerodynamic characteristics is presented. These results are used to provide a better understanding of the unsteady forces experienced by rapidly pitching wings at low speed conditions ranging from zero incidence to fully stalled flows. Dynamic rolling moments for the pitching model at steady side-slip are also discussed to illustrate asymmetric aerodynamic hysteresis effects. Finally, implications for aircraft flight dynamics modeling are discussed with particular emphasis on nonlinear time dependency effects. Author

N92-13025# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.
SOME CHARACTERISTICS AND EFFECTS OF THE F/A-18 LEX VORTICES
D. Brown, B. H. K. Lee, and F. C. Tang *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 20 p (For primary document see N92-12996 04-02)
Copyright Avail: NTIS HC/MF A23; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The first phase of a wind tunnel program to measure mean and unsteady forces and moments and pressure distributions on the forward fuselage, leading-edge extension (LEX), fins and in the LEX vortex wake of a 6 percent rigid model of the F/A-18 aircraft was accomplished. The effect of compressibility up to Mach 0.8 was studied. The mean chord Reynolds number range was 1.2 to 3.8 x 10(exp 6). Mean pressures were measured at 84 orifices distributed between canopy, forward fuselage, and the LEX. Unsteady and mean pressure measurements were made at four points on the LEX and at 24 points on each side of the fin. The vortex wake measurements were made with a 49 tube total

pressure rake of which 13 tubes were capable of acquiring unsteady as well as mean pressures. The effects of the LEX fences, that were retroactively fitted to CF-18 aircraft in service, were assessed. The influence on aircraft lift and pitching moments is small. The data shows their local effect on LEX pressures, reduction in fin mean and unsteady loading that they cause, and their effect on the stagnation pressure distribution in the vortex wake. Author

N92-13026# National Aeronautical Establishment, Ottawa (Ontario). Inst. for Aerospace Research.
MULTIPLE ROLL ATTRACTORS OF A DELTA WING AT HIGH INCIDENCE
E. S. Hanff and L. E. Ericsson (Lockheed Missiles and Space Co., Sunnyvale, CA.) *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 10 p (For primary document see N92-12996 04-02)
Copyright Avail: NTIS HC/MF A23; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A comprehensive roll oscillation test program on a 65 degree delta wing was conducted at the IAR (formerly NAE) 2 x 3 m low speed wind tunnel. The principle objectives of the program were to obtain a better insight of the vortex dynamics associated with large-amplitude and high-rate roll oscillations and to validate the hypersurface representation of aerodynamic loads as a means of improving prediction of aircraft dynamics in the nonlinear regime. Although some of the observed unusual roll response characteristics can be qualitatively explained in terms of existing knowledge regarding unsteady aerodynamic effects of separated flow, further tests and data analyses will be needed to reach the in-depth understanding of the flow phenomena which is required for the successful design of future high-agility aircraft. Author

N92-13027# Technical Univ. of Istanbul (Turkey). Faculty of Aeronautics and Astronautics.
NUMERICAL SIMULATION OF VORTEX STREET-EDGE INTERACTION
M. O. Kaya, C. R. Kaykayoglu, K. C. Bayar, and J. M. R. Graham (Imperial Coll. of Science and Technology, London, England) *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 12 p (For primary document see N92-12996 04-02)
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Preliminary results and computational method reviews are presented for the simulation of a vortex street impinging on three different leading edge geometries of sharp, blunt, and elliptic type, making use of Lagrangian and mixed Lagrangian-Eulerian vortex methods. Two new computer codes were developed to capture the essential features of the interaction mechanism near the edge surface. The first method utilizes a Discrete Vorticity Method (DVM) where a fixed Eulerian mesh system is needed to move the vortices through the flow domain. A more advanced computer model of the full Navier-Stokes equations of motion combines the Lagrangian convection and Eulerian diffusion schemes and is called the Hybrid Moving Vortex Diffusive Method (HMVDM). An unsteady shear layer flow arising from boundary layer separation at a bluff trailing edge creates the downstream vortex street. The models simulate most features of the impingement including the secondary vortex shedding as a truly self-generated phenomenon arising from impingement of the large-scale incident disturbances. The approaching vortex street is effected by the diverging flow around the elliptic edge. Vortex impingement on a blunt edge causes the most complex features of the interaction. The unsteady pressure distributions agree with the common observations. Author

N92-13028# Politecnico di Milano (Italy). Dipt. di Ingegneria Aerospaziale.
NUMERICAL SIMULATION OF VORTEX FLOWS PAST IMPULSIVELY STARTED WINGS
A. Baron, M. Boffadossi, and S. DePonte *In* AGARD, Vortex Flow Aerodynamics Jul. 1991 14 p (For primary document see N92-12996 04-02)
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A nonlinear unsteady vortex lattice method is used to predict the geometry of the wakes and the distribution of the aerodynamic loads on impulsively started wings. The wings are assumed to have negligible thickness, arbitrary aspect ratio, and planform. They can undergo a general unsteady motion. Multi-wing configurations can be treated. Wakes can be released in the flowfield from any of the sharp edges of the lifting surfaces, depending on planform, aspect ratio, and attitude of the wings. Particular emphasis is placed on the simulation of vortex core diffusion which is regarded as a prominent factor in a correct development of unsteady wakes. A vortex core diffusion model is proposed which seems to be able to deal even with the severe roll-up of the shear layers past highly swept multi-wing configurations with leading edge separation. The prediction capabilities of the method are verified by comparison of the numerical results with experimental data published by various authors. Author

N92-13029 North Carolina State Univ., Raleigh.
NUMERICAL INVESTIGATION OF UNSTEADY SUPERSONIC CAVITY FLOWFIELD WITH PASSIVE CONTROL Ph.D. Thesis
Insun Kim 1991 101 p
Avail: Univ. Microfilms Order No. DA9122008 CSCL 01A

A computational investigation of the supersonic turbulent flow over a two-dimensional rectangular cavity with passive control was conducted. The effect of passive control was included through the use of a porous surface over a vent chamber in the floor of the cavity. The passive control was numerically simulated by the use of a linear form of the Darcy pressure-velocity law. The time-accurate solutions of the two-dimensional Reynolds-averaged Navier-Stokes equations were generated using the explicit MacCormack scheme. The capability of the numerical scheme was first demonstrated by the computations of an open and closed cavity flow without passive control. The results of these computations also provided a reference case for the passive control computations. The effect of passive control on the open and closed cavity flows was then demonstrated and analyzed. The numerical results of open cavity flow with passive control suggested that the passive control effectively suppresses the pressure oscillations associated with the open cavity flow. Spectral analysis of the unsteady solution of open cavity flow showed that the cavity resonant frequencies are only slightly changed by the passive control and that the resonant frequencies of the cavity flow without passive control agree favorably with the predictions of the modified Rossiter's semi-empirical formula. The fluid dynamic mechanism of the control was seen to be a stabilization of the free-shear layer. Beneficial reductions in the cavity drag were also observed. Passive control applied to the closed cavity flow modified the flowfield to nearly that of an open cavity flow. The free-shear layer was seen to bridge the cavity completely. Drag reduction by a factor of 4 was achieved. The computational results showed good agreement with the available experimental data.
Dissert. Abstr.

N92-13030 Toledo Univ., OH.
EFFECTS OF INLET DISTORTION ON THE DEVELOPMENT OF SECONDARY FLOWS IN A SUBSONIC AXIAL INLET COMPRESSOR ROTOR Ph.D. Thesis
Albert Karl Owen 1991 340 p
Avail: Univ. Microfilms Order No. DA9122424

Detailed flow measurements were taken inside an isolated axial compressor rotor operating subsonically near peak efficiency. Laser anemometer measurements were made with two inlet velocity profiles. One profile consisted of an unmodified baseline flow, and the second profile was distorted by placing axisymmetric screens on the hub and shroud well upstream of the rotor. A primary flow is defined in the rotor, and deviations from this primary flow for each inlet flow condition are identified. A comparison between the two flow deviations is made to assess the development of a passage vortex due to the distortion of the inlet flow. A comparison of experimental results with computational predictions from a Navier-Stokes solver showed good agreement between predicted and measured flows. Measured results indicate that a distorted inlet profile has a minimal effect on the development of

the flow in the rotor passage and the resulting passage vortex.
Dissert. Abstr.

N92-13031 Notre Dame Univ., IN.
AN EXPERIMENTAL ANALYSIS OF CRITICAL FACTORS INVOLVED IN THE BREAKDOWN PROCESS OF LEADING EDGE VORTEX FLOWS Ph.D. Thesis
Kenneth Dale Visser 1991 285 p
Avail: Univ. Microfilms Order No. DA9122937

Experimental crosswire measurements of the flowfield above a 70 and 75 degree flat plate delta wing were performed at a Reynolds number of 250,000. Survey grids were taken normal to the planform at a series of chordwise locations for angles of attack of 20 and 30 degrees. Axial and azimuthal vorticity distributions were derived from the velocity fields. The dependence of circulation on distance from the vortex core as well as on chordwise location was examined. The effects of nondimensionalization in comparison with other experimental data was made. A reduction in the local circulation about the vortex axis occurred at breakdown. The spanwise distribution of axial vorticity was severely altered through the breakdown region and the spanwise distribution of axial vorticity present appeared to reach a maximum immediately preceding breakdown. The local concentration of axial vorticity about the vortex axis was reduced while the magnitude of the azimuthal vorticity decreased throughout the breakdown zone. The axial vorticity components unaffected by changes in wing sweep or angle of attack, in direct contrast to the positive components. The inclusion of the local wing geometry into a previously derived correlation parameter indicated the circulation of growing leading edge vortex flows to be similar at corresponding radii from the vortex axis. It was concluded that the flow over a delta wing, upstream of the breakdown regions and away from the apex and trailing edge regions, is conical. In addition, the dominating factors leading to the onset of breakdown are felt to be the local circulation of the vortex and the accompanying pressure field.
Dissert. Abstr.

N92-13032 Virginia Polytechnic Inst. and State Univ., Blacksburg.
OSCILLATING SHOCK IMPINGEMENT ON LOW-ANGLE GAS INJECTION INTO A SUPERSONIC FLOW Ph.D. Thesis
Charles Wade Wood 1991 191 p
Avail: Univ. Microfilms Order No. DA9123765

Experiments were performed to determine the effects of impinging oscillating shocks of different frequencies on a 115 deg. downstream angled, underexpanded, sonic helium jet injected into a supersonic airflow. Information on mixing, penetration, total pressure loss and turbulence structure from these experiments was used to estimate mixing control achieved by adding an oscillating shock to the helium injection flow field. The primary measurement made for the mixing studies was the molar concentration of helium. Concentration data, as well as mean flow data, was collected at nine lateral positions at each of three axial stations downstream of the helium injector. The resulting data produced contours of helium concentration, total pressure, Mach number, velocity, mass flux and static flow properties. Additional tests were conducted to determine the shock oscillation frequency, the correlation between the oscillating shock and the turbulence in the shear layer and the angle of large-scale structures in the flow. Mixing and penetration rates were determined from the helium concentration data. The major result was that impingement of an oscillating shock on a high-speed shear layer can be used to control the rate of mixing. It was found that increasing shock oscillation frequency resulted in more rapid injectant concentration decay and increased freestream air entrainment leading to a stoichiometric H2-air mixture ratio while also reducing penetration of the helium injectant. A strong correlation was found between the highest frequency shock and changes in the mixing flow field.
Dissert. Abstr.

N92-13033*# Brown Univ., Providence, RI. Div. of Applied Mathematics.
ACCURACY AND SPEED IN COMPUTING THE CHEBYSHEV COLLOCATION DERIVATIVE Final Report
Wai-Sun Don and Alex Solomonoff Washington NASA Dec. 1991 39 p
(Grant NAG1-1145)
(NASA-CR-4411; NAS 1.26:4411) Avail: NTIS HC/MF A03 CSCL 01A

We studied several algorithms for computing the Chebyshev spectral derivative and compare their roundoff error. For a large number of collocation points, the elements of the Chebyshev differentiation matrix, if constructed in the usual way, are not computed accurately. A subtle cause is is found to account for the poor accuracy when computing the derivative by the matrix-vector multiplication method. Methods for accurately computing the elements of the matrix are presented, and we find that if the entities of the matrix are computed accurately, the roundoff error of the matrix-vector multiplication is as small as that of the transform-recursion algorithm. Results of CPU time usage are shown for several different algorithms for computing the derivative by the Chebyshev collocation method for a wide variety of two-dimensional grid sizes on both an IBM and a Cray 2 computer. We found that which algorithm is fastest on a particular machine depends not only on the grid size, but also on small details of the computer hardware as well. For most practical grid sizes used in computation, the even-odd decomposition algorithm is found to be faster than the transform-recursion method.
Author

N92-13034# Naval Postgraduate School, Monterey, CA.
A STUDY OF THE AIRWAKE AERODYNAMICS OVER THE FLIGHT DECK OF AN AOR MODEL SHIP M.S. Thesis
Mark M. Rhoades Sep. 1990 102 p
(AD-A241008) Avail: NTIS HC/MF A06 CSCL 20/4

This study investigated the airwake of an AOR Class model ship to provide basic flow pattern and velocity information to aid in solving the elusive problem of blade strikes experienced by H-46 helicopters when they engage or disengage rotors aboard AOR ships. This investigation used the NPS flow visualization tunnel modified to simulate the atmospheric boundary layer. A detailed visualization was completed of the airflow near the flight deck area of a four-foot model in a stationary mode, utilizing helium bubbles, smoke, photographic and video equipment. The results show that the airwake is usually made up of two regions, one that is relatively smooth and one that is extremely turbulent. The dividing line is a shear layer that is created from the air flowing around the port face of the hangar. Another feature found both in the flow visualization, as well as the velocity measurements, was the presence of a significant upward component of flow over the port edge of the flight deck. It was found that this flow had nearly the same speed as the velocity measured at the ship's anemometer position but was inclined at an angle of between 15 and 25 degs. This upward flow, combined with the highly variable recirculations over the flight deck could be a significant contributing factor in the occurrence of blade strikes. In addition, some attempts were made to eliminate some of the more unruly flow patterns by using curved deflectors. These attempts had some success but will require further study.
GRA

N92-13035# Naval Postgraduate School, Monterey, CA.
AERODYNAMIC COEFFICIENTS OF A SYMMETRICAL AIRFOIL IN AN OSCILLATING FLOW M.S. Thesis
George A. Chamberlain, Jr. Sep. 1990 102 p
(AD-A241073) Avail: NTIS HC/MF A06 CSCL 01/1

A symmetrical airfoil at fixed angle of attack from 0 to 35 degrees was placed in an air flow with controlled velocity oscillations at 10 Hz. The instantaneous pressure distribution and flow velocity were measured simultaneously. Pressure information was integrated numerically to determine instantaneous values for lift, drag and moment about the quarter chord. The results were plotted as three-dimensional surface plots in angle of attack, cycle time and performance coefficient axes, or with chordwise position,

cycle time and pressure coefficient axes, as appropriate. The pressure distribution over the airfoil was shown to be primarily a function of freestream static pressure. Aerodynamic coefficients as a function of angle of attack and time exhibited seemingly random, erratic behavior, whereas the mean values of the same coefficients were similar in nature to those obtained in steady flow. The data indicate that the instantaneous performance of an airfoil in an oscillating flow is not merely a continuum of many quasi-steady states. GRA

N92-13036 Department of the Navy, Washington, DC.
STABILIZED SQUARE PARACHUTE Patent
Carl T. Calianno, inventor (to Navy) 6 Aug. 1991 6 p Filed 18 Apr. 1990
(AD-D015014; US-Patent-5,037,042; US-Patent-Appl-SN-518619; US-Patent-Class-244-145) Avail: US Patent and Trademark Office CSCL 01/3

This patent discloses a low cost square shaped parachute with trapezoidal panels attached to its canopy sides for controlling the air flow during operation to maximize drag and stability. GRA

N92-13037# Naval Postgraduate School, Monterey, CA.
WATER TUNNEL FLOW VISUALIZATION STUDIES OF A CANARD-CONFIGURED X-31A-LIKE FIGHTER AIRCRAFT MODEL M.S. Thesis
Hui M. Kwon Sep. 1990 118 p
(AD-A241362) Avail: NTIS HC/MF A06 CSCL 01/3

A water tunnel flow visualization investigation was performed to study the vortex bursting phenomena on a 2.3 percent scale model of a X-31A-like fighter aircraft. The main focus of this study was two-fold: (1) to determine the optimum canard location that produces favorable aerodynamic interference on the main wing, and (2) to determine the effect of pitch rate on the optimum-configured model during simple pitch-up and simple pitch-down maneuvers. It was found that a close-coupled canard configuration resulted in a more favorable interference between the vortex systems of the canard and the wing. The dynamic tests indicated that the location of the wing root vortex burst point relative to the static case moved downstream with increasing pitch rate. GRA

N92-13038*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECT OF SOLIDITY AND INCLINATION ON PROPELLER-NACELLE FORCE COEFFICIENTS
Garl L. Gentry, Jr., Dana Morris Dunham, and M. A. Takallu (Lockheed Engineering and Sciences Co., Hampton, VA.) Washington Dec. 1991 23 p
(NASA-TM-4316; L-16933; NAS 1.15:4316) Avail: NTIS HC/MF A03 CSCL 01A

A series of wind tunnel experiments were conducted to study the effect of propeller solidity and thrust axis inclination on the propeller normal force coefficient. Experiments were conducted in the Langley 14 by 22 foot Subsonic Tunnel with a sting mounted, counterrotation, scale model propeller and nacelle. Configurations had two rows of blades with combinations of 4 and 8 blades per hub. The solidity was varied by changing the number of blades on both rows. Tests were conducted for blade pitch setting of 31.34 deg, 36.34 deg, and 41.34 deg over a range of angle of attack from -10 deg to 90 deg and range of advance ratio from 0.8 to 1.4. The increase in propeller normal force with angle of attack is greater for propellers with higher solidity. Author

N92-13838*# Valparaiso Univ., IN. Dept. of Mechanical Engineering.
EXPERIENCES WITH OPTIMIZING AIRFOIL SHAPES FOR MAXIMUM LIFT OVER DRAG
Michael L. Doria *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 98-99 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

N92-13843*# Hampton Univ., VA.
A NUMERICAL METHOD FOR UNSTEADY AERODYNAMICS VIA ACOUSTICS
Steve Hodge *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 119-122 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

N92-13848*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
THE USE OF ARTIFICIAL NEURAL NETWORKS IN EXPERIMENTAL DATA ACQUISITION AND AERODYNAMIC DESIGN
Andrew J. Meade, Jr. *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 142-145 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

N92-13849*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
AN EVALUATION OF PRELIMINARY DOPPLER GLOBAL VELOCIMETRY MEASUREMENTS
L. Scott Miller *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 146-149 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

N92-13861*# Syracuse Univ., NY. Dept. of Mechanical and Aerospace Engineering.
CONSTANT-TEMPERATURE ANEMOMETRY MEASUREMENTS IN HYPERSONIC BOUNDARY LAYERS
Eric F. Spina *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 210-212 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

N92-13868*# California State Univ., Los Angeles. Dept. of Mechanical Engineering.
NAVIER-STOKES CALCULATION OF TRANSONIC FLOW PAST THE NTF 65 DEG DELTA WING
Chivey C. Wu *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 236-247 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-13039# National Transportation Safety Board, Washington, DC.
AIRCRAFT ACCIDENT REPORT: MARKAIR, INC., BOEING 737-2X6C, N670MA, CONTROLLED FLIGHT INTO TERRAIN, UNALAKLEET, ALASKA, 2 JUNE 1990
23 Jan. 1991 90 p
(PB91-910402; NTSB/AAR-91/02) Avail: NTIS HC/MF A05 CSCL 01C

On 2 Jun. 1990, at 0937 Alaskan Daylight Time, MarkAir, Inc. flight 3087, a Boeing 737-2X6C, registered in the U.S. as N670MA, crashed about 7.5 miles short of runway 14, Unalakleet, Alaska, while executing a localizer approach to that runway. The flight originated at 0828 at Anchorage International Airport. Instrument meteorological conditions existed at the time, and a flight attendant sustained minor injuries. Another flight attendant sustained serious

injuries. There were no passengers on board, and the airplane was destroyed. The flight was operated under FAR Part 121. The National Transportation Safety Board determines that the probable cause of this accident was deficiencies in flightcrew coordination, their failure to adequately prepare for and properly execute the UNK LOC Rwy 14 nonprecision approach and their subsequent premature descent. The safety issues that are discussed include cockpit resource management and approach chart symbology. This safety board issued a safety recommendation on approach chart standardization to the FAA. Safety recommendations were also issued to MarkAir, Inc., on the subjects of cockpit resource management and checklist usage. Author

N92-13040# National Academy of Sciences - National Research Council, Washington, DC. Committee for the Study of Air Passenger Service and Safety Since Deregulation.
WINDS OF CHANGE: DOMESTIC AIR TRANSPORT SINCE DEREGULATION
1991 415 p
(NRC-SR-230; ISBN-0-309-05104-5; LC-91-22773) Avail: NTIS HC/MF A18

A committee appointed by the National Research Council studied the effects of the Airline Deregulation Act of 1978 on domestic, commercial aviation, particularly on air passenger service, airline safety, airway capacity, and airline service quality. Both private and public sector issues were addressed. Issues such as the appropriate level of foreign investment in U.S. airlines were not examined. Deregulation has served to concentrate more of the market in fewer airlines, has contributed to intense competition, rapid change, and to some airlines' financial trouble. The committee makes specific recommendations for prudent government actions to improve competition, safety, and capacity, and also recommends a more thorough study to determine how best to organize the Federal Aviation Administration to act better on its responsibilities. It is noted that successful deregulated airlines have better management, are more effective competitors, and are likely to hold their own in future, global competition, but that financially weakened airlines, and the diminished number of airlines, are causes for concern. J.P.S.

N92-13041# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
DEVELOPMENT OF AN EMERGENCY UNDERWATER ESCAPE BREATHING SYSTEM FOR CH124 SEAKING AIRCREW
Wayne R. Sturgeon Apr. 1988 20 p
(DCIEM-87-TR-11; CTN-91-60227; AD-B123560L) Avail: NTIS HC/MF A03

A description is provided of research into and development of an underwater escape breathing system for use by Canadian Forces aircrew faced with the risk of water immersion and underwater escape from a downed aircraft. Details of a preliminary investigation of the U.S. Coast Guard Rebreather System are included. In addition, two other systems were evaluated: the Robertshaw system which was based on a SCUBA design and the Submersible Systems Inc. (SSI) system which was designed as an underwater escape system for divers. After several modifications and further testing, the SSI underwater escape breathing system was recommended for adoption by the Canadian Forces. Author (CISTI)

N92-13042# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
AIR-TO-AIR VISUAL ACQUISITION HANDBOOK
J. W. Andrews 27 Nov. 1991 76 p
(Contracts DTFA01-85-Z-02015; F19628-90-C-0002)
(ATC-151; DOT/FAA/PM-87/30) Avail: NTIS HC/MF A05

Described here is a set of computer programs that provide a practical means for predicting air-to-air visual acquisition performance for aircraft on collision courses. The programs are based upon a mathematical model of pilot visual acquisition performance. Guidelines are provided for selecting model parameters based upon previously collected flight test data. Selected results of computer analysis are provided. Author

N92-13043# Federal Aviation Administration, Atlantic City, NJ.
ONBOARD CABIN WATER SPRAY SYSTEM UNDER VARIOUS DISCHARGE CONFIGURATIONS
Timothy Marker Oct. 1991 27 p
(DOT/FAA/CT-TN91/42) Avail: NTIS HC/MF A03

Six full-scale fire tests were conducted in a modified DC-10 fuselage to investigate the effects of spraying water at different cabin locations or pre-wetting the cabin, while keeping the fire conditions constant. The tests were part of a 28 test series using a wide body fuselage to study the performance of an onboard cabin water spray system. The spray system utilizes low flow rate nozzles which produce a fine mist consisting of a range of water droplet diameters. The system being tested was a breadboard design for the purpose of demonstrating concept feasibility only. Two tests involved spraying water in different sections of the cabin and overhead. Two other tests investigated the effects of spraying varying quantities of water before the fire was ignited to pre-wet the interior. For comparison, one test used spray throughout the cabin, while the last test performed was without water in order to establish a baseline. Temperature, smoke, heat flux, and gas concentrations were monitored at various locations throughout the fuselage. Author

N92-13044*# Miami Univ., Coral Gables, FL. Dept. of Management Science.
THE IMPACT OF COCKPIT AUTOMATION ON CREW COORDINATION AND COMMUNICATION. VOLUME 1: OVERVIEW, LOFT EVALUATIONS, ERROR SEVERITY, AND QUESTIONNAIRE DATA
Earl L. Wiener, Thomas R. Chidester, Barbara G. Kanki, Everett A. Palmer, Renwick E. Curry, and Steven E. Gregorich (San Jose State Univ., CA.) Nov. 1991 152 p Sponsored by FAA
(Contract NCC2-581)
(NASA-CR-177587; NAS 1.26:177587) Avail: NTIS HC/MF A08 CSCL 01C

The purpose was to examine, jointly, cockpit automation and social processes. Automation was varied by the choice of two radically different versions of the DC-9 series aircraft, the traditional DC-9-30, and the glass cockpit derivative, the MD-88. Airline pilot volunteers flew a mission in the simulator for these aircraft. Results show that the performance differences between the crews of the two aircraft were generally small, but where there were differences, they favored the DC-9. There were no criteria on which the MD-88 crews performed better than the DC-9 crews. Furthermore, DC-9 crews rated their own workload as lower than did the MD-88 pilots. There were no significant differences between the two aircraft types with respect to the severity of errors committed during the Line-Oriented Flight Training (LOFT) flight. The attitude questionnaires provided some interesting insights, but failed to distinguish between DC-9 and MD-88 crews. Author

N92-13045# Federal Aviation Administration, Washington, DC.
AIRPORT ACTIVITY STATISTICS OF CERTIFICATED ROUTE AIR CARRIERS: CALENDAR YEAR 1990 Report, period ending 31 Dec. 1990
1990 544 p
(AD-A241483) Avail: NTIS HC/MF A23 CSCL 01/3

This report contains summary tables regarding: Summary of aircraft departures, enplaned revenue passengers, and enplaned revenue tons of cargo and mail by type of service, by carrier group, and by air carrier; Summary of aircraft departures, enplaned passengers, and enplaned revenue tons of cargo and mail by type of service, by state and U.S. Area; Aircraft departures, enplaned revenue passengers, and enplaned revenue tons of cargo and mail in total operations, all services at large air traffic hubs; Aircraft departures, enplaned revenue passengers, and enplaned revenue tons of cargo and mail in total operations, all services at medium air traffic hubs; Aircraft departures, enplaned revenue passengers, and enplaned revenue tons of cargo and mail in total operations, all services at small air traffic hubs. It contains detailed tables regarding: Enplaned revenue passengers, enplaned tons of cargo and mail, and air traffic hub classifications, by type of service,

by community, and by carrier; and Aircraft departures scheduled and aircraft departures performed, by aircraft type, by community, and by carrier. GRA

N92-13046# Federal Aviation Administration, Washington, DC.
FAA AIR TRAFFIC ACTIVITY: FY 1990. ADDENDUM Statistical Report, 1 Oct. 1989 - 30 Sep. 1990
1990 217 p
(AD-A241484) Avail: NTIS HC/MF A10 CSCL 01/5

This FAA publication furnishes terminal and en route air traffic activity information of the National Airspace System. The data have been reported by the FAA-operated Airport Traffic Control towers (ATCTs), Air Route Traffic Control Centers (ARTCCs), Flight Service Stations (FSSs/AFSSs/IFSSs), Approach Control Facilities, and FAA contract-operated towers. These reports are used as a guide in determining the need for larger or additional facilities and possible increases in personnel at existing facilities. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-13047 Colorado Univ., Boulder.
PRECISE REAL-TIME ORBIT DETERMINATION FOR APPLICATION TO GPS DIFFERENTIAL POSITIONING Ph.D. Thesis
Kuang-Chung Tu 1990 219 p
Avail: Univ. Microfilms Order No. DA9122649

GPS ephemeris errors are a critical factor in limiting the accuracy of surveying and precise positioning. A technique for GPS Real-time Orbit Determination (GPSROD), which can improve GPS orbit accuracy to the meter level or better, was successfully developed and is described here. Feasibility of performing GPSROD over a relatively short data arc with a short baseline station network has been studied and appears feasible. Covariance analysis was used to assist in filter design, model development, and error budget development. Detailed models of observable and surface forces are developed based on the requirement of GPSROD. A strategy of data processing and the corresponding algorithms are developed to make GPSROD more accurate and efficient. These include factorization and vector storage algorithms for both sequential and modified sequential filters. These filters are designed to require less memory and to avoid divergence. Furthermore, a consider filter for handling important bias parameters also has been developed and integrated into the GPSROD. The capability to process different types of data from GPS receivers has been built into the software. The program can easily switch from one filter mode to another with simple adjustments of a namelist input data file. Various real-time orbit determination cases are tested with encouraging results. Dissert. Abstr.

N92-13048# National Aerospace Lab., Tokyo (Japan). Control Systems Div.
THE OBSERVATIONS AND ANALYSIS OF SELECTIVE AVAILABILITY IN GPS
Masaaki Murata and Masatoshi Harigae (Toshiba Corp., Kawasaki, Japan) Apr. 1991 22 p In JAPANESE; ENGLISH summary
(NAL-TR-1105; ISSN-0389-4010) Avail: NTIS HC/MF A03

Selective Availability (SA) of the Global Positioning System (GPS) was tested from March 25 to August 28, 1990. The objective of SA is to degrade the positioning accuracy of civilian GPS users by intentionally adding errors to the broadcast ephemerides and satellite clocks of the GPS navigation message. SA is expected to be fully implemented by about mid-1993. Presently, only Block II GPS satellites have full SA capability. Author

N92-13049# Systems Control Technology, Inc., Arlington, VA.
HELIPORT VFR AIRSPACE DESIGN BASED ON HELICOPTER PERFORMANCE Final Report
Robert K. Anoll, Edwin D. McConkey, Robert J. Hawley, and Margaret B. Renton Aug. 1991 100 p
(Contract DTFA01-87-C-00014)
(SCT-90RR-34; DOT/FAA/RD-90/4) Avail: NTIS HC/MF A05

The results of the efforts to classify helicopters and heliports are presented based on the performance capabilities of a given rotorcraft and the projected ground and airspace available at a given heliport. Current visual flight rules (VFR) protected airspace requirements are not broad enough to cover the wide range of helicopter models and conditions in which they operate. Additionally, they do not always provide an adequate margin of safety from allowable obstructions near heliports with regard to the performance capabilities of the helicopters using those heliports. A recommendation is made to replace the single heliport imaginary surface with a system of surfaces which allow use of the heliport based on helicopter performance and also provides a safety margin between obstructions and rotorcraft climb capability. Another recommendation encourages helicopter manufacturers to include necessary performance data in their helicopter flight manuals to inform pilots of their aircraft's capability for operations at a confined area heliport or landing site. This is one of a series of five reports that addresses helicopter performance profile and their relationship to the VFR protected imaginary surfaces of approach and departure airspace at heliports. The other four are: (1) helicopter physical and performance data; (2) operational survey - VFR Heliport approaches and departures; (3) rotorcraft, acceleration, and climb performance model; and (4) helicopter rejected takeoff airspace requirements. Author

N92-13050# Klein Associates, Yellow Springs, OH.
PROTOTYPING AN ADAPTIVE DECISION AID FOR OFF-ROAD NAVIGATION Final Report, Aug. 1989 - Aug. 1990
Leslie A. Whitaker 28 Sep. 1990 31 p
(Contract DAAA15-89-C-0505)
(AD-A241260; KATR8909-90-04-Z) Avail: NTIS HC/MF A03 CSCL 17/7

A three-year project has been funded by the Human Engineering Laboratory to study off-road navigation. The goal of this contract is the development of a cognitive model of the offroad navigator. This model will take into account differences among individual navigators and their skill levels. The final product of this contract will be a prototype of an adaptive decision aid designed to support this navigation model. A paper prototype which illustrates the cognitive model will be developed. Klein Associates has completed the first year of work. This report describes the results of that year's effort. GRA

N92-13051# Federal Aviation Administration, Cambridge, MA. National Transportation Systems Center.
DESIGN CONSIDERATIONS FOR IAP CHARTS: APPROACH COURSE TRACK AND COMMUNICATION FREQUENCIES Final Report, Mar. 1990 - Jan. 1991
Jordan Multer, Margaret Warner, Robert DiSario, and M. S. Huntley, Jr. Aug. 1991 82 p
(AD-A241482; DOT-VNTSC-FAA-91-11; DOT/FAA/RD-91/19)
Avail: NTIS HC/MF A05 CSCL 17/7

This report describes two experiments evaluating format changes on instrument approach plates (IAPs). The study used a simple chart reading task to assess information transfer in IAPs. The first experiment addressed different methods of displaying approach course information. Three methods were evaluated: font size, bold type, and reverse video. Bold type had a negligible effect on chart reading performance. Both boxing and reverse video improved the speed with which items could be found and or identified on the chart. The use of font size as a method for presenting information was clear; a larger font size, 12 point, was more effective for presenting the inbound heading, than a smaller, 9 point size. The second experiment examined the effectiveness of four different layouts for displaying radio frequencies. Three of the four layouts were similar to those found in existing charts

published by NOAA, Jeppesen Sanderson, Inc. and the Canadian Department of Energy, Mines and Resources. The fourth layout was a two column layout, not currently found on existing charts. The two layouts analogous to the formats used by NOAA and Jeppesen Sanderson, Inc. resulted in similar performance. Performance in the two column layout and boxed layout was superior to performance in the NOAA and Jeppesen Sanderson, Inc. formats. Author (GRA)

N92-13052# Mitre Corp., Bedford, MA.
MOBILE MICROWAVE LANDING SYSTEM (MMLS): OPERATIONAL REQUIREMENTS FOR SETUP ACCURACY Final Report
Mo R. Danesh and Frederic D. Powell Aug. 1991 63 p
(Contract F19628-89-C-0001)
(AD-A241844; MTR-11120; ESD-TR-91-211) Avail: NTIS HC/MF A04 CSCL 17/7

This report examines, and determines, the accuracies required for the survey and alignment procedures in operational use of the Mobile Microwave Landing System such that the specified system accuracies will be satisfied in collocated and split-site Category 1 and 2 system deployments. The required accuracies are within the capabilities of modern survey equipment; in fact, less sophisticated methods such as pacing, or using the known length of the monitor cables, will suffice. Author (GRA)

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles see *85 Urban Technology and Transportation*.

N92-13053 Georgia Inst. of Tech., Atlanta.
A NUMERICAL SOLUTION OF IMPLICIT NONLINEAR EQUATIONS OF MOTION FOR ROTOR BLADES Ph.D. Thesis
Young Kil Kim 1991 161 p
Avail: Univ. Microfilms Order No. DA9124530 CSCL 01C

A comprehensive procedure for formulating nonlinear equations of motion implicitly is developed using a numerical treatment of the energies based on Hamilton's principle. This procedure is used to determine the aeroelastic response and aeroelastic stability characteristics of helicopter rotor blades in hover. The analysis is capable of handling initially curved and pretwisted rotor blades, which undergo large coupled extension, chordwise bending, flapwise bending, and torsion. The current development includes all higher order nonlinear structural terms in the equations of motion without using small deflection assumptions. Thus, the inconsistency of ordering schemes used in the previous works no longer exists. However, in order to express the equations in terms of displacements defined along the reference axis of the undeformed blade, the Euler-Bernoulli assumption is used to determine a transformation matrix between the undeformed position and the final deformed position. For the purpose of comparing the present implicit method with a comparable explicit formulation of the equations of motion, a simplified set of equations of motion are solved using a Galerkin type method. These procedures for the formulation of nonlinear solution method are coded and tested for the static deflection calculation of a very flexible beam and for the extensional deflection calculation of rotor blades in vacuum. Numerical results are also presented which show the steady and unsteady dynamic responses of hingeless rotor blades in hover. Finally, the results for an aeroelastic linear stability analysis of a cantilever rotor blade in hover are presented. It is concluded that the present method is a useful and accurate approach for the analysis of flexible nonrotating beams and rotor blades. Dissert. Abstr.

N92-13054*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PLANFORM CURVATURE EFFECTS ON FLUTTER CHARACTERISTICS OF A WING WITH 56 DEG LEADING-EDGE SWEEP AND PANEL ASPECT RATIO OF 1.14
Donald F. Keller, Maynard C. Sandford, and Theresa L. Pinkerton (Illinois Univ., Urbana.) Washington Sep. 1991 46 p
(NASA-TP-3116; L-16858; NAS 1.60:3116) Avail: NTIS HC/MF A03 CSCL 01C

An experimental and analytical investigation was initiated to determine the effects of planform curvature (curving the leading and trailing edges of a wing in the X-Y plane) on the transonic flutter characteristics of a series of three moderately swept wing models. Experimental flutter results were obtained in the Langley Transonic Dynamics Tunnel for Mach numbers from 0.60-1.00, with air as the test medium. The models were semispan cantilevered wings with a 3 percent biconvex airfoil and a panel aspect ratio of 1.14. The baseline model had straight leading and trailing edges (i.e., no planform curvature). The radii of curvature of the leading edges for these two models were 200 and 80 inches. The radii of curvature of the leading edges of the other two models were determined so that the root and tip chords were identical for all three models. Experimental results showed that flutter-speed index and flutter frequency ratio increased as planform curvature increase (radius of curvature of the leading edge was decreased) over the test range of Mach numbers. Analytical flutter results were calculated with a subsonic flutter-prediction program, and they agreed well with the experimental results. Author

N92-13055# Boeing Co., Seattle, WA.
DUAL MODE SHOCK ABSORBER AND METHOD Patent
Steven M. Warren, inventor 6 Feb. 1990 42 p
(Patent-1-265-541; Int-Patent-Class-F16F-948; CTN-91-60232)
Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC $4.00 CAN, MF $2.75 CAN

The subject of this invention is a dual mode shock absorber for use on aircraft. The shock absorber has a first mode of operation with a relatively high hydraulic orifice area that decreases during an initial compression, and a second mode of operation with a relatively small fixed orifice for dampening loads caused by relative extensions and compressions following the initial compression. This apparatus provides a new design approach for shock absorbers which is particularly well suited to the anticipated future requirements for military aircraft. The provision of two modes of load damping makes it possible to accomplish optimal absorption of landing impact energy and also to optimize the control of rough field taxi loads and aircraft motion during ground roll over damaged or semi-prepared runways. The system is highly reliable and automatically switches from landing mode to ground roll mode without human intervention. CISTI

N92-13056# National Research Council of Canada, Ottawa (Ontario). Inst. of Aerospace Research.
A PROPOSED COMPOSITE REPAIR METHODOLOGY FOR PRIMARY STRUCTURE
S. R. Hall, M. D. Raizenne, and D. L. Simpson 13 Jan. 1988 13 p
(NRC-LTR-ST-1658; CTN-91-60292) Avail: NTIS HC/MF A03

Advanced composite materials are used extensively in aircraft structures. One of the major problems that faces the operators of aircraft which use these materials, is that of structural repair. Composite structures require different repair techniques than do their metal counterparts. Presently, there is very little data available which permits composite structural repairs to be designed and evaluated. The databases and expertise which must be developed include basic materials data, analysis techniques which can be used to design and evaluate repair techniques, aircraft load zoning according to component criticality along with definition of the repairable damage that can occur in each zone, evaluation of the advantages and disadvantages of joining techniques which might be used in repair, development of nondestructive inspection techniques, identification of critical loads for composites,

development of suitable coupons for the evaluation of repair techniques, identification of the type of build-up structure that can be used to design and evaluate test and analytical methods, and development of methods to define, repair, and test repairs on build-up structures. Methods to predict built-up structure repair response must be made, and means of testing correlation between test and analytical results must be developed. Valid repair methods should be compiled in a repair manual. CISTI

N92-13057*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLAPPING INERTIA FOR SELECTED ROTOR BLADES
John D. Berry and Matthew J. May (Military Academy, West Point, NY.) Nov. 1991 60 p
(NASA-TM-104125; NAS 1.15:104125; AVSCOM-TR-91-B-019)
Avail: NTIS HC/MF A04 CSCL 01C

Aerodynamics of helicopter rotor systems cannot be investigated without consideration for the dynamics of the rotor. One of the principal properties of the rotor which affects the rotor dynamics is the inertia of the rotor blade about its root attachment. Previous aerodynamic investigation have been performed on rotor blades with a variety of planforms to determine the performance differences due to blade planform. The blades tested for this investigation have been tested on the U.S. Army 2 meter rotor test system (2MRTS) in the NASA Langley 14 by 22 foot subsonic tunnel for hover performance. This investigation was intended to provide fundamental information on the flapping inertia of five rotor blades with differing planforms. The inertia of the bare cuff and the cuff with a blade extension were also measured for comparison with the inertia of the blades. Inertia was determined using a swing testing technique, using the period of oscillation to determine the effective flapping inertia. The effect of damping in the swing test was measured and described. A comparison of the flapping inertials for rectangular and tapered planform blades of approximately the same mass showed the tapered blades to have a lower inertia, as expected. Author

N92-13058# Systems Control Technology, Inc., Arlington, VA.
HELICOPTER REJECTED TAKEOFF AIRSPACE REQUIREMENTS Final Report
Edwin D. McConkey, Robert J. Hawley, and Robert K. Anoll Aug. 1991 52 p
(Contract DTFA01-87-C-00014)
(SCT-91RR-28; DOT/FAA/RD-90/7) Avail: NTIS HC/MF A04

An analysis is given of performance data for helicopters that are certified for one engine inoperative (OEI) performance. It relates rejected takeoff and OEI capability to airspace requirements for heliports intended to support Category A operations. The current FAA regulation defining protected airspace and the imaginary surfaces associated with heliports does not take into consideration emergency situations involving engine failures during takeoff and landing operations. That is, the air and ground space defined by this regulation provides no margin of safety for acceleration or stopping distance for a rejected takeoff. Furthermore, it defines departure paths (climbout angles) that are too steep for many helicopters' OEI climbout capability. Suggested here is a more flexible airspace system, based on helicopter performance, that should apply to protected airspace at heliports supporting Category A operations. Author

N92-13059# Systems Control Technology, Inc., Arlington, VA.
ROTORCRAFT ACCELERATION AND CLIMB PERFORMANCE MODEL Final Report
Robert K. Anoll and Edwin D. McConkey Aug. 1991 47 p
(Contract DTFA01-87-C-00014)
(SCT-90RR-30; DOT/FAA/RD-90/6) Avail: NTIS HC/MF A03

The methodology is described used in developing the helicopter departure profiles. Each step involved in creating the profiles is examined. In particular, the Helicopter Departure Profile (HEDPRO) program is described in detail. This program converts helicopter performance data and departure procedures into departure profile data. The first step in developing profiles was to identify the departure procedures recommended by the manufacturers. Additionally, a safe confined area departure procedure needed to be developed. Next, climb and acceleration performance data specific to each helicopter and atmospheric condition was generated. This required extensive data to be collected for each helicopter. This data was then used in the Helicopter Sizing and Performance Computer Program (HESCOMP) developed to compute helicopter performance data. The last two steps were to compute and graph the profiles. HEDPRO was developed specifically for this project to compute the departure paths by determining the height/distance points of the path from the helipad. These points were then graphed to develop the final product. This methodology is described in sufficient detail so as to be valuable aid should other helicopter departure profiles need to be determined. Author

N92-13060# Systems Control Technology, Inc., Arlington, VA.
HELICOPTER PHYSICAL AND PERFORMANCE DATA Final Report
Edwin D. McConkey, Robert K. Anoll, Margaret B. Renton, and James Young Aug. 1991 196 p
(Contract DTFA01-87-C-00014)
(SCT-91RR-27; DOT/FAA/RD-90/3) Avail: NTIS HC/MF A09

A determination of physical and performance data for 8 civil helicopters was made. The used helicopters were chosen to exhibit a wide range of characteristics representative of the current civil fleet. Flight manual data as well as certification, flight test, and computer generated performance data were used to complete the study. Approach and departure profiles were developed for several gross weights and ambient conditions and translated into graphs. A menu-driven database was designed to provide easy access to the data. The airspace required for approaches is dependent upon pilot skill and desired approach slope. Pilots can fly approaches steeper than the current standard 8:1 surface if required though pilot workload tends to increase and comfort levels tend to decrease. The airspace required for departures is a function of aircraft performance and ambient conditions. Author

N92-13061# Army Lab. Command, Watertown, MA. Material Technology Lab.
FAILURE ANALYSIS OF THE APACHE MIXER PIVOT SUPPORT Final Report
Victor K. Champagne, Jr., Gary Wechsler, Marc S. Pepi, and Kirit J. Bhansali Jul. 1991 50 p
(AD-A240858; MTL-TR-91-25) Avail: NTIS HC/MF A03 CSCL 01/3

This report discusses a failure analysis of a mixer pivot support located on the AH-64 Apache Helicopter. The component was found to be broken in two pieces during an inspection. Visual inspection of the failed part revealed significant wear on surfaces that contacted the bushing and areas at the machined radius where the cadmium coating had been damaged allowing corrosion pitting to occur. Light optical microscopy showed that the crack origin was located at the machined radius within a region that was severely pitted. The hardness, chemistry, and microstructure of the electroslag remelted (ESR) 4340 steel used to fabricate the component conformed to required specifications and no apparent manufacturing defects were found. Electron microscopy showed that most of the fracture surface failed in an intergranular fashion with the exception of a shear lip zone which exhibited a dimpled morphology. The failure was set into action by hydrogen charging as a result of corrosion and was aggravated by the stress concentration effects of pitting at the radius and the high notch sensitivity of the material. Energy dispersive spectroscopy (EDS) determined that deposits of sand, corrosion, and salts were found within the pits. The failure mechanism was hydrogen assisted and was most likely a combination of stress corrosion cracking and corrosion fatigue. GRA

N92-13062# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
CHINA'S FIRST VARIABLE STABILITY AIRCRAFT: THE BW-1-GETS ITS PRE-ACCEPTANCE FLIGHT TESTS
Yuan Dong and Jian Yu 11 Sep. 1991 8 p Transl. into

ENGLISH from Guoji Hangkong (China), no. 2, 1990 p 13
(AD-A240941; FTD-ID(RS)T-0460-91) Avail: NTIS HC/MF A02 CSCL 01/3

The BW-1 variable stability aircraft, which our country designed on its own and refitted, is a research test plane for simulating aerial flight. The refit was completed in March of 1988. In November of the same year, it went through its initial flight technology review. Late in September of 1989, pre-acceptance flight tests on the aircraft were completed. Once this was done, our nation's aviation industry added yet another important type of means for scientific research. GRA

N92-13063# North Carolina Agricultural and Technical State Univ., Greensboro.
BEHAVIOR OF AIRCRAFT TIRE COUPONS UNDER VARIOUS LOADING CONDITIONS Final Report, Sep. 1987 - Dec. 1990
V. S. Avva, D. M. Pai, and R. L. Sadler Oct. 1991 146 p
(Contract F33615-87-C-3413)
(AD-A241416; WL-TR-91-3086) Avail: NTIS HC/MF A07 CSCL 01/3

The aircraft tire is a complex composite structure containing reinforcing nylon cords in a rubber matrix. It experiences a very complex loading during usage. There are inflation induced stresses as well as the centrifugal and flexural stresses induced by rolling. The material is exposed to cyclic thermal loading from heat generated by distortion and braking. All of these influence the useful life and performance of the tire. The tire designer needs to have an understanding of the constitutive properties of the aircraft tire and the influence of environment and loading on those properties. In this study, unused aircraft tires were cut open and specimens extracted to test for constitutive properties and a very important mechanical property called peel strength. The procedure for extracting the coupons, the fixturing and the simulated loading conditions used in the laboratory are discussed. Three kinds of peel test configurations were compared in a baseline study. The best configuration was then used to test conditioned coupons. The results and statistical analysis of these tests are presented. GRA

N92-13064*# PRC Systems Services Co., Edwards, CA.
AN AIRCRAFT MODEL FOR THE AIAA CONTROLS DESIGN CHALLENGE
Randal W. Brumbaugh Dec. 1991 17 p Presented at the AIAA GNC Conference, New Orleans, LA, 12 Aug. 1991 Previously announced in IAA as A91-49779
(Contract NAS2-12722)
(NASA-CR-186019; H-1777; NAS 1.26:186019; AIAA-91-2631)
Avail: NTIS HC/MF A03 CSCL 01C

A generic, state-of-the-art, high-performance aircraft model, including detailed, full-envelope, nonlinear aerodynamics, and full-envelope thrust and first-order engine response data is described. While this model was primarily developed Controls Design Challenge, the availability of such a model provides a common focus for research in aeronautical control theory and methodology. An implementation of this model using the FORTRAN computer language, associated routines furnished with the aircraft model, and techniques for interfacing these routines to external procedures is also described. Figures showing vehicle geometry, surfaces, and sign conventions are included. Author

N92-13842*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
FORMULATION OF THE LINEAR MODEL FROM THE NONLINEAR SIMULATION FOR THE F18 HARV
Charles E. Hall, Jr. *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 115-116 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N92-13065*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECT OF SHORT-TERM EXPOSURE TO STEREOSCOPIC THREE-DIMENSIONAL FLIGHT DISPLAYS ON REAL-WORLD DEPTH PERCEPTION
Anthony M. Busquets, Russell V. Parrish, and Steven P. Williams Washington Oct. 1991 26 p
(DA Proj. 1L1-61102-AH-45)
(NASA-TP-3117; L-16897; NAS 1.60:3117;
AVSCOM-TR-91-B-014) Avail: NTIS HC/MF A03 CSCL 01D

High-fidelity color pictorial displays that incorporate depth cues in the display elements are currently available. Depth cuing applied to advanced head-down flight display concepts potentially enhances the pilot's situational awareness and improves task performance. Depth cues provided by stereopsis exhibit constraints that must be fully understood so depth cuing enhancements can be adequately realized and exploited. A fundamental issue (the goal of this investigation) is whether the use of head-down stereoscopic displays in flight applications degrade the real-world depth perception of pilots using such displays. Stereoacuity tests are used in this study as the measure of interest. Eight pilots flew repeated simulated landing approaches using both nonstereo and stereo 3-D head-down pathway-in-the-sky displays. At this decision height of each approach (where the pilot changes to an out-the-window view to obtain real-world visual references) the pilots changed to a stereoacuity test that used real objects. Statistical analysis of stereoacuity measures (data for a control condition of no exposure to any electronic flight display compared with data for changes from nonstereo and from stereo displays) reveals no significant differences for any of the conditions. Therefore, changing from short-term exposure to a head-down stereo display has no more effect on real-world relative depth perception than does changing from a nonstereo display. However, depth perception effects based on sized and distance judgements and on long-term exposure remain issues to be investigated. Author

N92-13066# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
SOVIET ELECTRONIC DISPLAY SYSTEMS UNDER RESEARCH AND MANUFACTURED FOR THE CIVIL AVIATION AIRCRAFT OF THE 1990'S
Ling Zhiqin 25 Jul. 1991 12 p Transl. into ENGLISH from Aviation Production Engineering (China), no. 5, May 1989 p 28 and 29
(AD-A240933; FTD-ID(RS)T-0289-91) Avail: NTIS HC/MF A03 CSCL 14/2

For many years, scientific research and production of on-board electronic equipment on Soviet civil aviation aircraft primarily directed its efforts to the resolution of the problems of guaranteeing a high degree of flight safety, and lowering operating expenses. Lightening the operating responsibilities of the aircrews is an effective method of raising the safety of flying. The operating responsibilities of aircrew personnel are primarily determined by the information capacity and orderliness of the whole set of on-board equipment. The question of lightening aircrew operating responsibilities, in the last ten years, has had special practical significance. The reason for this is that, in this time period, civil aviation aircraft have been equipped with various types of new model guidance and communications gear, automatic flight control equipment, and electric supply equipment. In conjunction with this, there has been a choice to make use of new piloting principles, such as those based on opting for the use of overall energy amount information. GRA

N92-13067# Wright Lab., Wright-Patterson AFB, OH.
LIMITATIONS OF A HOLOGRAPHIC 3-D PIXEL PROJECTOR FOR COCKPIT DISPLAYS
Shawn L. Kelly and Charles T. Robinson Aug. 1991 5 p
(AD-A241295; WL-TM-91-601) Avail: NTIS HC/MF A01 CSCL 14/4

One popular approach to increasing the combat capability of an aircraft is to reduce the pilot workload imposed by the interpretation of large quantities of displayed data into useful information. One facet of that workload is the mental exercise required by the pilot to visualize his dynamic three dimensional (3-D) environment given data presented on two dimensional (2-D) cockpit displays. Therefore, it is a primary thrust of cockpit research to explore, develop, and test new display devices which can present data with the full 3-D image characteristics of stereopsis, full look-around, and ocular accommodation so that the magnitude of required mental visualization is greatly reduced. GRA

N92-13858*# Appalachian State Univ., Boone, NC. Dept. of Mathematical Sciences.
BACKGROUND ISSUES FOR ON-LINE AIRCRAFT DOCUMENTATION
C. Ray Russell *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 198-201 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01D

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-13068# National Aerospace Lab., Tokyo (Japan).
LOW OXYGEN COMBUSTION TESTER FOR HIGH TEMPERATURE REHEAT COMBUSTORS
Shuji Yamada, Kazuo Shimodaira, and Masashi Horiuchi Apr. 1989 17 p In JAPANESE; ENGLISH summary
(DE90-505516; NAL-TM-605) Avail: NTIS (US Sales Only) HC/MF A03

As a part of the development of high efficiency reheat cycle gas turbines, the combustion tester capable of testing under various oxygen content conditions at a combustor inlet was developed to examine the flame holding, combustion, and emission characteristics of combustors in high temperature low oxygen combustion. The tester allowed to supply the gas of low oxygen content (11 percent) and 1086 K for combustion experiments of a half scale combustor model. The oxygen content of air was reduced to 11 percent by using an existing aeroplane gas turbine combustor as a preheat combustor. The temperature of as-preheated gas (1500 K) was lowered with the latent heat of the water injected into the gas in a water-evaporizating cooler, and temperature profiles were obtained from the gas sampled at the combustor exit. The experimental results show that the cooler could efficiently obtain the required gas temperature at pressures of 5-8 atm and at an air/water ratio of 10 (nearly equal to design specifications). DOE

N92-13069# General Electric Co., Fairfield, CT.
GAS TURBINE ENGINE CONTROL Patent
Ronald S. Carpenter, inventor, Frederick J. Pineo, inventor, and William L. Gazzola, inventor 25 Sep. 1990 12 p
(Patent-1-274-606; Int-Patent-Class-G10L-914; Int-Patent-Class-G10L-908; CTN-91-60235) Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC $4.00 CAN, MF $2.75 CAN

An invention is presented which relates to a thrust droop compensator designed to improve gas turbine engine control. Such a compensator reduces the droop in thrust which sometimes occurs because of different rates of thermal growth of various engine components during engine acceleration. This compensator consists of a gas engine control which modulates a variable exhaust nozzle as a function of parameters which include a temperature error signal. CISTI

N92-13070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF A COMPUTER ALGORITHM FOR THE ANALYSIS OF VARIABLE-FREQUENCY AC DRIVES: CASE STUDIES INCLUDED
M. David Kankam and Owen Benjamin (Cornell Univ., Ithaca, NY.) Nov. 1991 34 p
(NASA-TM-105327; E-6688; NAS 1.15:105327) Avail: NTIS HC/MF A03 CSCL 21E

The development of computer software for performance prediction and analysis of voltage-fed, variable-frequency AC drives for space power applications is discussed. The AC drives discussed include the pulse width modulated inverter (PWMI), a six-step inverter and the pulse density modulated inverter (PDMI), each individually connected to a wound-rotor induction motor. Various d-q transformation models of the induction motor are incorporated for user-selection of the most applicable model for the intended purpose. Simulation results of selected AC drives correlate satisfactorily with published results. Future additions to the algorithm are indicated. These improvements should enhance the applicability of the computer program to the design and analysis of space power systems. Author

N92-13071*# Sverdrup Technology, Inc., Brook Park, OH.
UNSTEADY BLADE PRESSURES ON A PROPFAN AT TAKEOFF: EULER ANALYSIS AND FLIGHT DATA Final Report
M. Nallasamy Nov. 1991 12 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(Contract NAS3-25266)
(NASA-CR-189076; E-6706; NAS 1.26:189076; AIAA-92-0376)
Avail: NTIS HC/MF A03 CSCL 21E

The unsteady blade pressures due to the operation of the propfan at an angle to the direction of the mean flow are obtained by solving the unsteady three dimensional Euler equations. The configuration considered is the eight bladed SR7L propfan at takeoff conditions and the inflow angles considered are 6.3 deg, 8.3 deg, 11.3 deg. The predicted blade pressure waveforms are compared with inflight measurements. At the inboard radial station ($r/R = 0.68$) the phase of the predicted waveforms show reasonable agreement with the measurements while the amplitudes are over predicted in the leading edge region of the blade. At the outboard radial station ($r/R = 0.95$), the predicted amplitudes of the waveforms on the pressure surface are in good agreement with flight data for all inflow angles. The measured (installed propfan) waveforms show a relative phase lag compared to the computed (propfan alone) waveforms. The phase lag depends on the axial location of the transducer and the surface of the blade. On the suction surface, in addition to the relative phase lag, the measurements show distortion (widening and steepening) of the waveforms. The extent of distortion increases with increase in inflow angle. This distortion seems to be due to viscous separation effects which depend on the azimuthal location of the blade and the axial location of the transducer. Author

N92-13072# Naval Postgraduate School, Monterey, CA.
FURTHER CALCULATIONS OF THE PERFORMANCE OF TURBOFAN ENGINES INCORPORATING A WAVE ROTOR M.S. Thesis
James W. Roberts Sep. 1990 107 p
(AD-A240867) Avail: NTIS HC/MF A06 CSCL 21/5

Two recent computer programs, WRCOMP and ENGINE, by A. Mathur, were used to examine the performance to be gained by incorporating a wave rotor component in a turbofan engine

with mixed exhausts. The programs were transferred to a VAX-2000 computer, extended, and test cases reported by A. Mathur were successfully reproduced. A comparison was made between ENGINE, in which real gas effects are accounted for, and ONX (by J. Mattingly) in which constant specific heats are used. The inclusion of real gas effects proved to have a significant impact on the predicted performance. An extension of Mathur's results was made by varying the overall pressure ratio in the wave-turbofan engine. Further cycle studies and experiments to measure wave rotor component performance are recommended. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N92-13073*# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
ADVANCED ROTORCRAFT CONTROL USING PARAMETER OPTIMIZATION Semiannual Progress Report
Brett VanSteenwyk and Uy-Loi Ly 1991 71 p
(Grant NAG2-691)
(NASA-CR-189502; NAS 1.26:189502) Avail: NTIS HC/MF A04 CSCL 01C

A reliable algorithm for the evaluation of a quadratic performance index and its gradients with respect to the controller design parameters is presented. The algorithm is part of a design algorithm for an optimal linear dynamic output feedback controller that minimizes a finite time quadratic performance index. The numerical scheme is particularly robust when it is applied to the control law synthesis for systems with densely packed modes and where there is a high likelihood of encountering degeneracies in the closed loop eigensystem. This approach through the use of a accurate Pade series approximation does not require the closed loop system matrix to be diagonalizable. The algorithm has been included in a control design package for optimal robust low order controllers. Usefulness of the proposed numerical algorithm has been demonstrated using numerous practical design cases where degeneracies occur frequently in the closed loop system under an arbitrary controller design initialization and during the numerical search. Author

N92-13074# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
H(INFINITY) OPTIMAL CONTROL THEORY OVER A FINITE HORIZON Interim Report, Jan. - Aug. 1991
M. B. Subrahmanyam Sep. 1991 30 p
(AD-A240898; NADC-91077-60) Avail: NTIS HC/MF A03 CSCL 01/4

In this report a finite horizon H infinity optimal control problem is treated. Results guaranteeing the existence of a unique optimal control and the worst exogenous input are derived. A criterion for the evaluation of the infimal H infinity norm is then given in terms of the least positive value for which a certain boundary value problem has a nontrivial solution. Once the infimal value is known, a noninfimal value can be selected and suboptimal H controllers can be synthesized. The problem of synthesizing suboptimal H controllers is also considered in a very general case. Without making use of any transformations, expressions for the output feedback controller are derived in terms of solutions of two dynamic Riccati equations. In the time-invariant case, the solutions of these equations usually converge to constant matrices. GRA

N92-13075# California Univ., Los Angeles. Dept. of Mechanical Aerospace and Nuclear Engineering.
CONTROL AUGMENTED STRUCTURAL OPTIMIZATION OF AEROELASTICITY TAILORED FIBER COMPOSITE WINGS Final Report, 11 Nov. 1986 - 30 Sep. 1990
Peretz P. Friedmann and Lucien A. Schmit, Jr. 18 Aug. 1991 71 p
(Contract F49620-87-K-0003)
(AD-A241464; AFOSR-91-0786TR) Avail: NTIS HC/MF A04 CSCL 01/3

The problem of control augmented structural optimization of aeroelastically tailored fiber composite wings was addressed in a series of comprehensive studies. This research culminated in the first truly integrated, practical computer program capable of treating this multidisciplinary synthesis problem by simultaneously changing structural, aerodynamic, and control type design variables for practical aircraft configurations. The effectiveness and efficiency of this integrated aeroservoelastic optimization capability was displayed by applying it to an RPV type vehicle as well as the more complex F-16 and X-29 type airplane models. In addition, within the framework of this research, a digital adaptive controller capable of suppressing flutter in composite wings under time varying flight conditions in subsonic and transonic flow was developed. This efficient analysis can be used as the basis for structural optimization studies of actively controlled composite wings in transonic flow. GRA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-13076# General Accounting Office, Washington, DC.
AEROSPACE TECHNOLOGY: TECHNICAL DATA AND INFORMATION ON FOREIGN TEST FACILITIES
Jun. 1990 584 p
(GAO/NSIAD-90-71FS; B-235387) Avail: NTIS HC/MF A25; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

This report provides data and information collected by the General Accounting Office (GAO) on foreign government and industry investment in aerospace vehicle research and technological development efforts. The focus is on those critical or enabling technologies that could allow foreign countries to develop and build future aerospace vehicles. The report also identifies indicators for measuring foreign countries' current state of aerospace vehicle technological development and progress. The review includes France, West Germany, the United Kingdom, and Japan, since each of these countries are developing technologies for various concepts of operational aerospace vehicles to secure independent access to space and reduce the costs of launching payloads into orbit. Also included are facilities, such as wind tunnels, in The Netherlands, Belgium, Italy, and Australia because their test facilities are being used to conduct research and development of air-breathing aerospace vehicles by other countries and the European Space Agency (ESA). Information was collected on test facilities, their capabilities, and the number of people working on aerospace vehicle research and development in the countries that were included in the review. Facilities include (1) wind tunnels and shock tunnels, (2) air-breathing propulsion test cells (engine test facilities for ramjets and scramjets), (3) aerothermal test facilities, (4) aeroballistic and impact ranges, (5) advanced materials research, development, production, and fabrication laboratories, and (6) aerodynamic computation facilities (supercomputers). Cost information collected on test facilities included construction, replacement, annual operating, and, where available, user costs. J.P.S.

N92-13077# Systems Control Technology, Inc., Arlington, VA.
NEW YORK DOWNTOWN MANHATTAN (WALL STREET) HELIPORT: OPERATIONS ANALYSIS Final Report
Deborah J. Peisen and Roy Lobosco Sep. 1991 156 p
(Contract DTFA01-87-C-00014)
(DOT/FAA/RD-91/12; Rept-91RR-12) Avail: NTIS HC/MF A08

The operational characteristics of the Downtown Manhattan Heliport, commonly known as the Wall Street Heliport, located in New York City were analyzed. Although selected for the Federal Aviation Administration (FAA)/Industry National Prototype Heliport Demonstration and Development Program in 1983, this heliport was opened in 1960. A general overview of the number of helicopter operations since 1960 and a detailed analysis of operational characteristics between 1987 and 1989, the time frame for which detailed data was available, is provided. Furthermore, the developmental history of the heliport is discussed. The analysis of the operations at the heliport is performed using data collected by the Port Authority of New York and New Jersey (PANYNJ), the owner and operator of the heliport. The parameters examined concentrate on the variations and trends in the number of operation by year, month, week, time of day, mission type, engine type, and number of passengers carried. Author

N92-13078# Wright Lab., Wright-Patterson AFB, OH.
SUSCEPTIBILITY OF A PARALLELOGRAM TYPE SKIN FRICTION BALANCE TO ROTATIONAL MOTION
R. N. Demers and J. E. Leugers Sep. 1991 15 p
(AF Proj. 2404)
(AD-A241348; WL-TM-91-326) Avail: NTIS HC/MF A03 CSCL 14/2

The Flight Dynamics Directorate at Wright-Patterson Air Force Base (WPAFB) is currently involved in skin friction research in the Mach 3 and Mach 6 High Reynolds Number Facilities (HRNF). The current instrument used to measure the shearing forces is a modified version of the NASA Langley parallelogram type skin friction balance tailored for operation in adverse thermal and dynamic environments. Although the balance has provided excellent results in both the Mach 3 and Mach 6 HRNF facilities, some concerns exist with the data at the very lowest stagnation pressures at Mach 3. At these low pressure (at P(sub os) of 80 psia) the balance and other measuring instruments experience erratic signal outputs. The concern therefore is whether the erratic behavior of the balance is due to tunnel vibration at low stagnation pressures or to aerodynamic conditions within the tunnel. A laboratory test was devised to determine at what frequency and amplitude the balance would experience erratic behavior. This report investigates the vibration test and analysis on the skin friction balance. GRA

N92-13079# Air Force Academy, CO.
A 3-DEGREE-OF-FREEDOM FLIGHT SIMULATOR EVALUATION OF UNSTEADY AERODYNAMICS EFFECTS
C. B. Harmon and William Dieterich Aug. 1991 81 p
(AF Proj. 2307)
(AD-A241540; FJSRL-TR-91-0002) Avail: NTIS HC/MF A05 CSCL 01/1

This report documents the delivery of a 3-degree-of-freedom flight simulator for the use of researchers in the field of unsteady aerodynamics. The software is distributed to qualified users via 3-1/2 inch high density diskette. The flight simulation was designed to be portable across programming languages and computer operating systems. It was written in the C programming language under MSDOS and subsequently ported to VAX/VMS, first in C then in Ada. The input files are identical under both operating systems and both languages. The output files are identical across these environments except for minor differences under Ada. The C source files are different only in their syntax for the use of include files. The build (make) files are different as are the binary object and executables. The documentation files are identical. GRA

N92-13080# Ballistic Research Labs., Aberdeen Proving Ground, MD.
APPLICATION OF DIGITAL MEASUREMENT TECHNIQUES TO ANALYSIS OF RANGE SHADOWGRAPHS Final Report, Jun. - Sep. 1988
Richard A. Beyer, Anthony J. Kotlar, and Maureen R. Beyer Sep. 1991 29 p
(AD-A241554; BRL-TR-3271) Avail: NTIS HC/MF A03 CSCL 14/4

Range shadowgraphs have been digitized using a solid state video camera and a relatively unsophisticated personal computer-based frame grabber board. Image processing, including edge enhancement and level discrimination were used to provide data files for further analysis. A simultaneous multiparameter least squares fitting program was used to determine position and angle of the projectile in the image relative to fiducial markers. Analysis of accuracy and guidelines for future production systems are given. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N92-13081# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE
30 Jul. 1990 71 p Transl. into ENGLISH of various Russian articles
(JPRS-USP-90-003) Avail: NTIS HC/MF A04

Space research in the U.S.S.R. is discussed. Topics covered include manned mission highlights, space sciences, interplanetary sciences, space engineering, space applications, and space policy. For individual titles, see N92-13082 through N92-13087.

N92-13082# Joint Publications Research Service, Arlington, VA.
COMMENTARY ON GRANAT PROJECT **c18**
R. Syunyayev *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 16-17 Transl. into ENGLISH from Pravda, Moscow (USSR), 3 Dec. 1989 p 6 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

General information is given on the Granat Project. Granat is the first specialized x-ray and gamma-ray satellite produced by the U.S.S.R. The observatory's scientific instruments include the ART-P and ART-S astronomical x-ray telescopes. Granat also carries a large set of gamma ray-burst equipment. Operation of the spacecraft and some of its observations are briefly surveyed. Author

N92-13083# Joint Publications Research Service, Arlington, VA.
RESULTS FROM PLANT GROWTH EXPERIMENTS ABOARD ORBITAL STATIONS **c51**
A. Volkov, S. Krikalev, and G. Nechitaylo *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 28-29 Transl. into ENGLISH from Pravda, Moscow (USSR), 22 Oct. 1989 p 3 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

A general description of research involving plant growth experiments aboard U.S.S.R. orbital space stations is given. Weightlessness effects, gravitational effects, and the plant development cycle in relation to life support systems are briefly discussed. The development of a new polymer material, polyacrylamide gel, is described. Other experiments with animal and plant tissues are described. Author

N92-13084# Joint Publications Research Service, Arlington, VA.
SATALLITE SYSTEMS FOR GLOBAL ECOLOGICAL MONITORING **c45**
B. Konovalov *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 33-34 Transl. into ENGLISH from Izvestiya, Moscow (USSR), 3 Jan. 1990 p 3 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

An interview with N. N. Sheremetyevskiy, the Soviet director of the attempt to create a system of Soviet meteorological and natural resource satellites is given. Discussed are the Soviets' technical capabilities to create a global ecological patrol, the practical and research tasks that could be accomplished by having

a constant ecological patrol, and international cooperation.
Author

N92-13085# Joint Publications Research Service, Arlington, VA.
ALTERNATIVE PROPOSAL FOR SPACE PRODUCTION, POLYUS MODULE LAUNCH REVEALED **c29**
Dmitriy Alekseyevich Polukhin *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 39-40 Transl. into ENGLISH from Pravda, Moscow (USSR), 17 May 1990 p 3 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

In general terms a proposal to build a space factory from several space modules is discussed. The program would be for the manufacture of semiconductors, optical glasses, biological preparations, and pharmaceuticals. Author

N92-13086# Joint Publications Research Service, Arlington, VA.
DEBATE ON USE OF NUCLEAR POWER SOURCES IN SPACE. SAGDEYEV POINTS TO DANGER OF NUCLEAR INSTALLATIONS ABOARD SPACECRAFT **c20**
R. Sagdeyev *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 44-48 Transl. into ENGLISH from NTR Tribuna, Moscow (USSR), no. 3-4, Feb. 1990 p 10 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

The danger of contamination as a result of an accident involving launch vehicles or spacecraft carrying nuclear power sources is discussed. A worst case scenario involving an accident during launch, which would turn all the plutonium into fine powder and would scatter it in the atmosphere over great distances is analyzed. A table is given listing U.S. launched spacecraft with nuclear energy sources on board. Author

N92-13087# Joint Publications Research Service, Arlington, VA.
PONOMAREV-STEPNOY REBUTS ARGUMENTS OF NUCLEAR DANGERS IN SPACE **c20**
N. Ponomarev-Stepnoy *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 48-50 Transl. into ENGLISH from NTR Tribuna, Moscow (USSR), No. 3-4, Feb. 1990 p 11 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

It is argued that the use of nuclear reactors in spacecraft is a necessity and that the dangers resulting from accidents have been exaggerated. Author

N92-13088*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEEP SPACE NETWORK: MISSION SUPPORT REQUIREMENTS
Oct. 1991 212 p
(NASA-CR-185938; JPL-870-14-Rev-AF; JPL-D-0787-Rev-AF; NAS 1.26:185938) Avail: NTIS HC/MF A10 CSCL 22A

The purpose is to provide NASA and Jet Propulsion Laboratory management with a concise summary of information concerning the forecasting of the necessary support and requirements for missions described here, including the Earth Radiation Budget Experiment, the Cosmic Background Explorer, the Comet Rendezvous Asteroid Flyby, the Cassini, and the Dynamics Explorer-1. A brief description of various missions along with specific support requirements for each are given. For individual titles, see N92-13089 through N92-13133.

N92-13089*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
ASTRO-D
G. W. Ousley, Sr. and Y. Tanaka *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

ASTRO-D, which is to be launched by a MU-3II vehicle, is a scientific Earth orbiting satellite of the Institute of Space and Astronomical Science (ISAS) of Japan. It will be launched in Uchinoura, Kagoshima Prefecture, Japan. The Deep Space Network will support 4 to 8 contacts per day, depending on the launch and early orbit phase (LEOP) and mission phase, providing only downlink telemetry recording to all stations. Data is given in tabular form for network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13090*# National Space Development Agency, Tokyo (Japan).
BROADCASTING SATELLITE-3A AND -3B (BS-3A AND 3B)
M. Horii and K. Funakawa *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirments Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The BS-3A and -3B will provide direct color TV broadcasting to the Japanese mainland and remote islands. The satellites will be launched from Tanegashima Space Center by a type H-1 launch vehicle. The coverage will consist of the 26-m antenna and the 34-m antenna as a backup support for the transfer and drift orbits. Maximum support will consist of one 8-hour track per station for a seven day period, plus 23 days of contingency support from all complexes. Information is given in tabular form for Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13091*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CRAF/CASSINI (C/C)
R. Draper and J. Casani *In its* Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Comet Rendezvous Asteroid Flyby (CRAF) is a mission to rendezvous with the comet Tempel 2 and to station-keep at the comet for a period of 2.6 years, including the comet perihelion. There is a flyby of the asteroid Mandeville prior to the arrival at Tempel 2. The Cassini is a mission to place a spacecraft in a highly elliptical orbit around the planet Saturn and deliver a probe to the surface of its satellite Titan. There is a flyby of the asteroid 1989 UR1 prior to arrival at Saturn. Coverage goals for the two missions are explained. Information is given in tabular form for frequency assignments, telemetry, command, navigation, and tracking support responsibility. Author

N92-13092*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COSMIC BACKGROUND EXPLORER (COBE): EMERGENCY SUPPORT
R. Stanford and R. Mattson *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Cosmic Background Explorer (COBE) Mission will measure the diffuse radiation from the universe in the wavelength band 1 micron to 9.6 mm. The band includes the 3 K cosmic background radiation, the known relic of the primeval cosmic explosion. The COBE satellite will be launched from the Western Space and Missile Center (EWSMC) via a Delta launch vehicle into a circular parking orbit of about 300 km. COBE will be placed into a 900-km altitude circular orbit. Coverage will be provided by the Deep Space Network (DSN) for COBE emergencies that would prevent communications via the normal channels of the Tracking and Data Relay Satellite System (TDRSS). Emergency support will be provided by the DSN 26-m subnetwork. Information is given in tabular form for DSN network support, frequency assignments, telemetry, and command. Author

N92-13093*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DYNAMICS EXPLORER-1 (DE-1)
F. Gordon and P. Pashby *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Dynamics Explorer (DE) mission is designed to study the Earth's electromagnetic fields at varying heights up to 4 Earth radii. The DE-1 was launched on a Delta 3913 launch vehicle from the Western Test Range and was placed in a 561 x 23279 km orbit with a 90 degree inclination. The Deep Space Network (DSN) began to support this extended mission on February 1, 1985. Coverage consists of five passes per day that last for 45 minutes each. Information is given in tabular form for DSN support, frequency assignments, telemetry, command, and tracking mission responsibility. Author

N92-13094*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EARTH RADIATION BUDGET SATELLITE (ERBS): EMERGENCY SUPPORT
J. Williamson and P. Pashby *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The primary purpose of the Earth Radiation Budget Satellite (ERBS) project is to study the Earth's atmospheric processes and their relationship to the Earth's climate. Following deployment from the Space Shuttle, the satellite was maneuvered into a circular orbit of 610 km x 610 km x 57 degrees, with a period of 99.6 minutes. The Deep Space Network (DSN) will support the ERBS during emergency situations in the event that the standard Tracking and Data Relay Satellite System (TDRSS) to White Sands data link is inoperative. Emergency support will be provided by the DSN's 26-meter antenna subnetwork. Information is given in tabular form for DSN network support, frequency assignments, telemetry, and command. Author

N92-13095*# National Space Development Agency, Tokyo (Japan).
ENGINEERING TEST SATELLITE VI (ETS-VI)
M. Horii and K. Funakawa *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Engineering Test Satellite-VI (ETS-VI) is being developed as the third Japanese three-axis stabilized engineering test satellite to establish the 2-ton geostationary operational satellite bus system and to demonstrate the high performance satellite communication technology for future operational satellites. The satellite is expected to be stationed at 154 deg east latitude. It will be launched from the Tanegashima Space Center in Japan by a type H-II launch vehicle. The Deep Space Network (DSN) will support the prelaunch compatibility test, data interface verification testing, and launch rehersals. The DSN primary support period is from launch through the final AEF plus 1 hour. Contingency support is from final AEF plus 1 hour until launch plus 1 month. The coverage will consist of all the 26-m antennas as prime and the 34-m antennas at Madrid and Canberra as backup. Maximum support will consist of two 8-hour tracks per station for a 7-day period, plus the contingency support, if required. Information is given in tabular form for DSN support, telemetry, command, and tracking support responsibility. Author

N92-13096*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Wessling (Germany, F.R.).
EUROPEAN TELECOMMUNICATIONS SATELLITE II (EUTELSAT II)
G. Laemmel and P. Brittinger *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

EUTELSAT II is a regional public telecommunications system for Europe. The services which will be provided are telephone and television. The satellites will be placed at a geostationary orbit within the arcs of 6 degrees east to 19 degrees east or 26 degrees to 36 degrees east. The designed lifetime is 7 years. After separation of the satellites from the launch vehicles, telemetry, telecommand, and ranging will be performed within the S-band frequencies. After positioning of the satellite at its final geostationary orbit, the Ku-band telecommunication equipment will be activated. From this time on, all satellite control operations will be performed in Ku-band. The Deep Space Network (DSN) will support the transfer and drift orbit mission phases. The coverage will consist of the 26-m antennas at Goldstone and Canberra as prime support for the transfer and drift orbits. Maximum support will consist of a 7-day period, plus 14 days of contingency support. Information is given in tabular form for DSN support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13097*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EXTREME ULTRAVIOLET EXPLORER (EUVE): EMERGENCY SUPPORT
H. Zayas and J. Barrowman *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirments Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Extreme Ultraviolet Explorer (EUVE) will conduct a survey of the entire celestial sphere in the extreme ultraviolet (UV) spectrum, 100 to 1000 angstrom units. This survey will be accomplished using four grazing incidence telescopes mounted on a spinning spacecraft whose spin axis is along the Sun line. Data is taken only when the spacecraft is in the Earth's shadow. The EUVE will be placed in a near circular orbit by a Delta expendable launch vehicle. The design orbit is circular at an altitude of 550 km by 28.5 degrees for a period of 96 minutes. The EUVE will be flown on a standardized Explorer Platform (EP) which will be reused for followup Explorer missions. Coverage will be provided by the Deep Space Network (DSN) for EUVE emergencies that would prevent communications via the normal channels of the Tracking and Data Relay Satellite System (TDRSS). Emergency support will be provided by the 26-meter subnet. Data is presented in tabular form for DSN support, frequency assignments, telemetry, and command. Author

N92-13098*# Centre National d'Etudes Spatiales, Toulouse (France).
FRENCH DIRECT TV BROADCAST SATELLITE (TDF-1 AND -2)
R. Vacheyroux and A. Pouzet *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The French Direct TV Broadcast Satellite (TDF-1 and -2) missions are to provide three channels of TV and sound broadcasting to France within the 12 to 18 GHz bands. The satellites will be placed in a geostationary orbit at 19 degrees west longitude. The satellites will be launched from the Centre Spatial Guyanis in French Guiana on an Ariane launch vehicle. The Deep Space Network (DSN) will support the transfer and drift orbit mission phases. The coverage will consist of the 26-m antennas at Goldstone and Canberra as prime support. Maximum support will consist of two 8-hour tracks per station for a 7-day period, plus 14 days contingency support. Information is given in tabular form for DSN coverage, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13099*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GALILEO
N. E. Ausman and W. J. ONeil *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 6 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The purpose of the Galileo missions is to make observations of Jupiter and its satellites using an orbiting spacecraft and an atmospheric entry probe. The mission will determine the chemical composition and physical state of the Jovian atmosphere and its satellites, and the topology and behavior of the magnetic field and energetic particle flux of Jupiter. The mission plan calls for a

Venus Earth Earth Gravity Assist (VEEGA) trajectory having a launch to end of mission duration of approximately 8 years. The Galileo spacecraft was placed in Earth orbit by the Space Transportation System (STS) on October 18, 1989. The Inertial Upper Stage (IUS) placed the spacecraft on a trajectory to encounter Venus on February 10, 1990. Information is given in tabular form for coverage goals, Deep Space Network (DSN) support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13100*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GAMMA RAY OBSERVATORY (GRO): EMERGENCY SUPPORT
K. Schauer and J. Madden *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Gamma Ray Observatory (GRO) is an Earth orbiting satellite that studies sources of localized, galactic, and extragalactic gamma rays. It will be carried into a near-circular orbit by the Space Shuttle, following which it will be placed in its operational orbit by its on-board hydrazine propulsion system. Formal orbit parameters are 350 km x 450 km x 28.5 degrees with a period of 93 minutes. Deep Space Network coverage will be provided during emergencies that would prevent communications via the normal Tracking and Data Relay Satellite System (TDRSS)-White Sands data link. Emergency support will be provided by the DSN's 26-meter antenna subnetwork. Information is given in tabular form for DSN support, frequency assignments, telemetry, and command. Author

N92-13101*# National Space Development Agency, Tokyo (Japan).
GEOSTATIONARY METEOROLOGICAL SATELLITE-5 (GMS-5)
M. Horii *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Geostationary Meteorological Satellite (GMS-5), which is being developed by the National Space Development Agency of Japan (NASDA), is the fifth geostationary, spin stabilized, weather satellite. Its purposes are to observe cataclysmic events such as hurricanes, typhoons, and regional weather phenomena; to relay meteorological data from surface collection points to the Data Processing Center in Japan; and to transmit processing imaging data for facsimile reproduction. The satellite will be launched from the Tanegashima Space Center (TaSC) in Japan by a type H-II launch vehicle. The Deep Space Network (DSN) will support the transfer and drift orbit mission phases. The coverage will consist of the 26-m antennas as prime and the 34-m antenna at Madrid as backup support for launch through drift orbit. Maximum support will consist of two 8-hour tracks per station for a seven day period, plus 23 days of contingency support from all complexes. Information is given in tabular form for DSN support, frequency assignments, telemetry, command and tracking station responsibility. Author

N92-13102*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE (GOES I-M) METSAT PROJECT
K. Blaney and C. Thienel *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The primary objective of the METSAT project is to provide a satellite system that meets the National Environmental Satellite Data and Information Service (NESDIS) requirements as specified by NOAA. For the GOES I-M spacecraft, these requirements include an imager and sounder system, a data collection system, and a search and rescue system. The Space Transportation System and GOES I-M development philosophy and the satellite transfer orbit philosophy are explained. The spacecraft will be launched from the Kennedy Space Center using Atlas G/Centaur D-1A expendable launch vehicles. The coverage required for launch and the support of transfer and drift orbits will consist of the 26-m antenna as prime and the TBD antenna as backup for 11 days at all complexes. There will be contingency support 15 days for on-station spacecraft checkout. After the initial 30 to 45 days, the Deep Space Network (DSN) is committed for emergency support. Contingency and emergency support will be provided by Goldstone only. Information is given in tabular form for DSN support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13103*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Wessling (Germany, F.R.).
GERMAN TELECOMMUNICATIONS SATELLITE (DEUTSCHER FERNMELDE SATELLIT) (DFS-1 AND -2)
G. Hiendlmeier and H. Schmeller *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The German Telecommunications Satellite (DFS) Program is to provide telecommunications service for high data rate transmission of text and video data to the Federal Republic of Germany within the 11-14 GHz and 20-30 GHz bands. The space segment of this program is composed of three satellites, DFS-1, DFS-2, and DFS-3, which will be located at 23.5 degrees E longitude of the geostationary orbit. The DFS will be launched from the Center Spatial Guyanis in French Giana on an Ariane launch vehicle. The mission follows the typical injection sequence: parking orbit, transfer orbit, and earth orbit. Attitude maneuvers will be performed to orient the spacecraft prior to Apogee Kick Motor (AKM) firing. After AKM firing, drift phase orbital and attitude maneuvers will be performed to place the spacecraft in its final geostationary position. The Deep Space Network (DSN) will support the transfer and drift orbit mission phases. Information is presented in tabular form for the following areas: DSN support, compatibility testing, frequency assignments, telemetry, command, and tracking support responsibilities. Author

N92-13104*# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
GIOTTO EXTENDED MISSION (GEM)
D. E. B. Wilkins and M. Grensemann *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The primary objectives of the Giotto Extended Mission (GEM), are to determine the composition and physical state of the Grigg Skjellerup Comet's nucleus; to determine the processes that govern the composition and distribution of neutral and ionized species in the cometary atmosphere. Giotto consists of a single European Space Agency (ESA) spacecraft that was launched in 1985 from Center Spatial Guyanis in French Guiana on an Ariane launch vehicle. After a successful launch into geostationary orbit and a heliocentric transfer trajectory, the spacecraft successfully encountered Halley's Comet in 1986. One month after encountering Halley's Comet, Mar. 1986, the spacecraft was placed in hibernation in a heliocentric orbit slightly less than 1 AU. Between Feb. and Jul. 1990 the spacecraft was successfully reactivated, checked out, and placed on a trajectory course to intercept comet Grigg Skjellerup. The spacecraft has been in hibernation since Jul. 1990. Information is presented in tabular form in the following areas: coverage goals, Deep Space Network Support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13105*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GOLDSTONE SOLAR SYSTEM RADAR (GSSR) **c14**
N. A. Renzetti *In its* Deep Space Network: Mission Support Requirements Oct. 1991 8 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 14B

The primary objective of the Goldstone Solar System Radar is the investigation of solar system bodies by means of Earth-based radar. Targets of primary interest include the Galilean moons,

Saturn's rings and moons, and Earth-approaching asteroids and comets. Planets are also of interest, particularly Mercury and the planets to which NASA has not yet planned spacecraft visits. Based on a history of solid achievement, including the definition of the Astronomical Unit, imaging and topography of Mars, Venus, and Mercury, and contributions to the general theory of relativity, the program will continue to support flight project requirements and its primary objectives. The individual target objectives are presented, and information on the following topics are presented in tabular form: Deep Space Network support, compatibility tests, telemetry, command, and tracking support responsibility. Author

N92-13106*# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
HIPPARCOS
In JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 2 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The primary objective of Hipparcos is to provide very accurate star map data and star position accuracies on the order of 2 arc seconds. Hipparcos was planned to be in a geostationary orbit, but due to failure of the apogee motor, it is currently in a high elliptical orbit and has a 10.8 hour period. Goldstone 26 m will provide 6-8 hours per day support for real-time telemetry and command. Mission-dependent equipment is required at Goldstone, and telemetry and command data will be transmitted from Goldstone to European Space Operations Control Center (ESOC) via satellite links. Operations support is scheduled to begin 12 Mar. 1990. Author

N92-13107*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
HUBBLE SPACE TELESCOPE (HST): EMERGENCY SUPPORT c89
J. Repass (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) and F. Wojtalik *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 03A

The Hubble Space Telescope (HST) is a national facility that consists of a 2.4-m aperture Ritchey-Chretien cassegrain telescope weighing approximately 9525 kg with various energy detectors designed for the observation of IR, visible, and UV wavelengths (0.12 to 1000 microns). The HST was deployed into a 28.5-degree inclination, circular orbit, which permits a mission lifetime of 15 years. The orbit is decaying circular between 594 and 400 km x 28.5 deg; the period = 95 minutes. Information is presented in tabular form on the following areas: Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13108*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INTERNATIONAL COMETARY EXPLORER (ICE)
R. Wales and P. Pashby *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The primary mission objectives of the International Cometary Explorer (ICE) Comet Mission are to determine the composition and physical state of the Giacobini-Zinner Comet's nucleus; to determine the processes that governs the composition and distribution of neutral and ionized species in the cometary atmosphere; and to investigate the interaction between the solar wind and the cometary atmosphere. The spacecraft was in a halo orbit around the Sun-Earth libration point until it was moved 10 Jun. 1982 to the Earth's Geomagnetic Tail (GT). The spacecraft reached the GT in Jan. 1983 and remained there until Dec. 1983, at which time a lunar swing-by placed the spacecraft in a trajectory heliocentric orbit which encountered the comet Giacobini-Zinner in Sep. 1985. The spacecraft provided observations of solar wind upstream of Halley's Comet in 1986. Information is presented in tabular form and includes the following areas: Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibilities. Author

N92-13109*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INTERNATIONAL SOLAR TERRESTRIAL PHYSICS (ISTP) PROGRAM
R. Sanford, D. Muhonen, and K. O. Sizemore *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 2 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The International Solar Terrestrial Physics (ISTP) Program is a large, multi-national program involving three space agencies and up to eight spacecraft. NASA, together with the Institute of Space and Astronomical Science (ISAS) and the European Space Agency (ESA), has agreed in principle to coordinate their efforts in investigating the Sun and the Earth. Each agency is planning to construct and operate different spacecraft as part of this cooperative venture: Geotail provided by ISAS, the Solar Heliospheric Observatory (SOHO) and Cluster (four spacecraft) contributed by ESA, and Wind and Polar by NASA. A general description of the program is presented. Author

N92-13110*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTERNATIONAL SOLAR TERRESTRIAL PHYSICS (ISTP) GEOTAIL MISSION
R. Sanford and K. O. Sizemore *In its* Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Geotail spacecraft will be provided by the Institute of Space and Astronautical Science (ISAS) and will provide a Delta Launch Vehicle, tracking support by the Deep Space Network (DSN), and data processing support by GSFC. In exchange, ISAS will reserve part of the payload for NASA instruments together with a certain number of investigators from the United States. As the solar wind flows toward the Earth, some of the energy is modified by the Earth's magnetosphere, ionosphere, and upper atmosphere. This interaction causes the flow to be altered, creating a plasmasphere, plasma sheet, and ring currents in the Earth's Geomagnetic Tail region. The result is a series of distinct regions which affect processes on the Earth. By traversing the tail region to a variety of depths, Geotail will be able to determine the size, position, and other properties of these regions. When correlated with information obtained from the other ISAS spacecraft, Geotail data should help to provide a more complete understanding of how the solar processes affect the Earth's environment. The flight profile is given, and information is presented in tabular form on the following topics: DSN support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13111*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INTERNATIONAL SOLAR TERRESTRIAL PHYSICS (ISTP) WIND MISSION
R. Sanford and K. O. Sizemore *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 2 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The launch of the WIND spacecraft will place the satellite into a sunside apogee double-lunar swing-by orbit for a period of one year, after which WIND may be transferred to a Sun-Earth L1 Halo orbit. Information is presented in tabular form on the following topics: Deep Space Network support; frequency assignments, telemetry, command, and ranging. Author

N92-13112*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INTERNATIONAL SOLAR TERRESTRIAL PHYSICS (ISTP) PROGRAM POLAR MISSION

R. Sanford and K. O. Sizemore *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 2 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The polar spacecraft will be launched from Western Test Ranges (WTR) into a 2 earth radii by 9 earth radii polar orbit, with apogee near the North Pole. Information is presented on the following topics: Deep Space Network support, frequency assignments, telemetry, command, and ranging. Author

N92-13113*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LANDSAT 4 AND 5: EMERGENCY
W. Webb and L. Gonzales *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The primary purpose of LANDSAT is to study Earth resources. Each satellite contains a Thematic Mapper (TM) and a Multispectral Scanner (MSS) imaging device plus mission unique hardware. The flight profile is presented, and information is presented in tabular form on the following topics: Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13114*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LASER GEODYNAMIC SATELLITE (LAGEOS II)
C. Portelli and G. W. Ousley, Sr. *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Laser Geodynamic Satellite 2 (LAGEOS 2) is nearly identical to the LAGEOS 1 satellite, which was launched by NASA in 1976. However, LAGEOS 2 is completely passive, and is equipped with fused silian corner reflectors for ranging with ground-based lasers. The addition of LAGEOS 2 will provide the GSFC laser network with significantly increased satellite tracking opportunities, because LAGEOS 1 is at a 110-degree inclination and LAGEOS 2 will be at a 52-degree inclination. The flight profile is given, and information is presented in tabular form on the following topics: Deep Space Network support, frequency assignments, telemetry, tracking, and tracking support responsibility. Author

N92-13115*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MAGELLAN
J. Scott and A. Spear *In its* Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Magellan Mission consists of a single spacecraft to be placed in an elliptical orbit around Venus. The main objective of the mission is to perform radar imaging, altimetry, and reflectivity of 90 percent of the planet for one Venusian year (243 days). A flight profile is given, and information is presented in tabular form on the following topics: Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibilities. Author

N92-13116*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MARS OBSERVER
S. Dallas and D. D. Evans *In its* Deep Space Network: Mission Support Requirements Oct. 1991 6 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The Mars Observer Mission will deliver a single spacecraft to Mars for an extended orbital study of the planet's surface, atmosphere, and gravitational and magnetic fields. A flight profile is given, and information is presented in tabular form on the following topics: Deep Space Network support; compatibility tests, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13117*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
MUSES-A
T. Nishimura and T. Hayashi *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The MUSES-A spacecraft mission objectives are to study the effect of a double lunar swingby technique, lunar orbital insertion, obtain experience using optical navigation equipment, measure mass and momentum of micrometeoroids by using a particle dust counter, and to support a packet telemetry and Reed-Solomon coding experiment by using a newly developed fault tolerant onboard computer. A flight profile is given, and information is presented in tabular form on the following topics: Deep Space Network support, frequency assignments, telemetry, command, and tracking support responsibility. Author

N92-13118*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NIMBUS-7
M. Foreman and P. Pashby *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Nimbus 7 are summarized. The basic Nimbus series spacecraft is attitude-stabilized in three axes, with the yaw axis always pointing towards the center of the Earth. The spacecraft provides a stable platform, power, command, and data handling support for active and passive sensors for daily global surveillance of the atmosphere, and for mapping details of the atmospheric structure and Earth surface from satellite altitudes. The Nimbus 7 mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; S-band frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13119*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OCEAN TOPOGRAPHY EXPERIMENT (TOPEX/POSEIDON): EMERGENCY SUPPORT
R. A. Stiver and C. A. Yamarone *In its* Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for the Ocean Topography Experiment (TOPEX/Poseidon) and the Global Positioning System (GPS) demonstration are summarized. The TOPEX mission consists of a single spacecraft which will be placed in a high earth circular orbit, with an altitude of 1334 km and a 63-deg inclination. The TOPEX mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; and tracking support responsibility. M.G.

N92-13120*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PIONEER 6 THROUGH 8
D. Lozier and R. Fimmel *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Pioneer 6, 7 and 8 are summarized. The primary objective of these Pioneer missions is to collect scientific data relative to interplanetary phenomena within a range of approximately 0.8 to

1.2 astronomical units from the sun. Following orbital injection, each spacecraft was oriented with its spin axis normal to the ecliptic plane so that the high gain antenna pattern would be aligned with Earth's orbit. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profiles; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13121*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PIONEER 10 AND 11
D. Lozier and R. Fimmel *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Pioneer 10 and 11 are summarized. The primary objective of these Pioneer missions is to investigate the interplanetary medium beyond the orbit of Saturn and, in particular, to gather data which may locate the heliopause as these spacecraft cruise out of the solar system to the extreme of their communication capabilities. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13122*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PIONEER 12 (PN-12)
D. Lozier and R. Fimmel *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Pioneer 12 are summarized. The Pioneer 12 spacecraft is in a 24-hour elliptical orbit around Venus. Atmospheric and altimetry data are obtained mainly around periapsis, and planetary imaging is normally performed around apoapsis. The Pioneer 12 mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13123*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ROENTGENSATELLIT (ROSAT)
F. Guckenbiehl and G. W. Ousley, Sr. *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for ROSAT (Roentgensatellit) are summarized. ROSAT is an international cooperative program between NASA and the Bundesministerium fuer Forschung and Technologie (BMFT). The satellite was launched on a Delta 2 vehicle and placed in a circular orbit at an altitude of 580 km, with a 53-deg inclination. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry and command; and tracking support responsibility. M.G.

N92-13124*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SAMPEX
J. Catena and G. Colon *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for SAMPEX are summarized. SAMPEX is the first mission of the GSFC Small Explorer Satellite program (SMEX). Its primary scientific objectives are to measure the elemental and isotopic composition of solar energetic particles, anomalous cosmic rays, and galactic cosmic rays over the energy range from approximately one to several hundred MeV per nucleon. The SAMPEX mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13125*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
SOLAR-A
K. Ninomiya and Y. Ogawara *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for SOLAR-A are summarized. The SOLAR-A mission objectives are to investigate high energy phenomena of the Sun using x-ray telescopes and spectrometers during the maximum activity period of the solar cycle. The spacecraft will be launched into a circular earth orbit of approximately 500 km altitude and 31 deg inclination. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13126*# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
SPACE FLYER UNIT (SFU)
T. Ninomiya and K. Kuriki *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for the Space Flyer Unit (SFU) are summarized. The SFU is an unmanned, reusable, and retrievable free-flying platform for multipurpose use. The SFU spacecraft will carry seven individual experiments to be completed during its mission period. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13127*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE TRANSPORTATION SYSTEM (STS): EMERGENCY SUPPORT **c16**
T. Janoski (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) and L. Nicholson *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22B

The DSN (Deep Space Network) mission support requirements for emergency support of the Space Transportation System (STS) are summarized. Coverage would be provided by the DSN during emergencies that would prevent communications between the shuttle and the White Sands TDRSS receiving station. The DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13128*# Centre National d'Etudes Spatiales, Toulouse (France).
TELECOM 2-A (TC2A)
J. Dulac and J. Latour *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Telecom 2-A (TC2A) are summarized. The Telecom 2-A will provide high-speed data link applications, telephone, and television service between France and overseas territories. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13129*# Centre National d'Etudes Spatiales, Toulouse (France).
TELECOM 2-B AND 2-C (TC2B AND TC2C)
J. Dulac and H. Alvarez *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Telecom 2-B and 2-C (TC2B and TC2C) are summarized. These Telecom missions will provide high-speed data link applications, telephone, and television service between France and overseas territories as a follow-on to TC2A. Mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13130*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS)
J. McKenzie and C. Vanek *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 3 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for the Tracking and Data Relay Satellite System (TDRSS) are summarized. The TDRSS consists of four identical satellites in geosynchronous orbits (35,800 km) and a dedicated ground station. The payload of each satellite is a telecommunications service system that relays communication signals between low earth-orbiting user spacecraft and the TDRSS ground terminal. Mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13131*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ULYSSES
W. Meeks and F. Beech *In its* Deep Space Network: Mission Support Requirements Oct. 1991 5 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for Ulysses are summarized. The primary goal of the Ulysses mission is to explore the Sun, its environment, and possible links between solar variability and terrestrial weather and climate. The Ulysses spacecraft will be injected into an interplanetary orbit toward Jupiter after which the spacecraft travels in a heliocentric, out-of-ecliptic orbit with high heliographic inclination. The Ulysses mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13132*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
UPPER ATMOSPHERE RESEARCH SATELLITE (UARS): EMERGENCY SUPPORT
S. Osler and V. Moore *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for the Upper Atmospheric Research Satellite (UARS) are summarized. The UARS satellite will be placed into a circular orbit of 600 km and 57 deg inclination with a period of 97 minutes. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, command and support systems; and tracking support responsibility. M.G.

N92-13133*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VOYAGER INTERSTELLAR MISSION (VIM)
R. Rudd and G. Textor *In its* Deep Space Network: Mission Support Requirements Oct. 1991 8 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22A

The DSN (Deep Space Network) mission support requirements for the Voyager Interstellar Mission (VIM) are summarized. The general objectives of the VIM are to investigate the interplanetary and interstellar media and to continue the Voyager program of ultraviolet astronomy. The VIM will utilize both Voyager spacecraft for the period from January 1990 through December 2019. The mission objectives are outlined and the DSN support requirements are defined through the presentation of tables and narratives describing the spacecraft flight profile; DSN support coverage; frequency assignments; support parameters for telemetry, control and support systems; and tracking support responsibility. M.G.

N92-13847*# Wichita State Univ., KS. Dept. of Industrial Engineering.
APPLICATION OF MULTIPLE CRITERIA DECISION METHODS IN SPACE EXPLORATION INITIATIVE DESIGN AND PLANNING
Abu S. M. Masud *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 134-141 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 22A

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-13134 Illinois Univ. at Urbana-Champaign, Savoy.
OPTIMAL FINITE-THRUST SPACECRAFT TRAJECTORIES USING DIRECT TRANSCRIPTION AND NONLINEAR PROGRAMMING Ph.D. Thesis
Paul James Enright 1991 122 p
Avail: Univ. Microfilms Order No. DA9124409

A class of methods for the numerical solution of optimal control problems is analyzed and applied to the optimization of finite-thrust spacecraft trajectories. These methods use discrete approximations to the state and control histories, and a discretization of the equations of motion to derive a mathematical programming problem which approximates the optimal control problem, and which is solved numerically. This conversion is referred to as transcription. Recent advances in nonlinear programming, however, have made

it feasible to solve the original heavily-constrained nonlinear programming problem, which is referred to as the direct transcription of the optimal control problem. This method is referred to as direct transcription and nonlinear programming. A recently developed method for solving optimal trajectory problems uses a piecewise-polynomial representation of the state and control variables and enforces the equations of motion via a collocation procedure, resulting in a nonlinear programming problem, which is solved numerically. This method is identified as being of the general class of direct transcription methods described above. Also, a new direct transcription method which discretizes the equations of motion using a parallel-shooting approach is developed. Both methods are applied to thrust-limited spacecraft trajectory problems, including finite-thrust transfer, rendezvous, and orbit insertion, a low-thrust escape, and a low-thrust Earth-moon transfer. Dissert. Abstr.

N92-13135# Naval Postgraduate School, Monterey, CA.
AUTOMATIC SATELLITE IMAGE NAVIGATION M.S. Thesis
Brian C. Spaulding Sep. 1990 93 p
(AD-A240895) Avail: NTIS HC/MF A05 CSCL 17/9

The satellite image navigation system for AVHRR (Advanced Very High Resolution Radiometer) imagery at the Naval Postgraduate School, referred to as Avian, has been modified from an operator interactive procedure to an automatic navigation procedure. The interactive procedure, based on operator identification of discrete landmarks, has been replaced with a procedure which utilizes the Defense Mapping Agency's (DMA) World Vector Shoreline (WVS) as a reference. Binary shoreline images are created from the satellite images and correlated with the WVS reference shoreline using a sum of absolute differences matching technique. The correlation is performed using reference and search windows selected from full resolution sub-scenes of the WVS and satellite image. Ten images were navigated with resulting accuracies of approximately 1.3 km. The resultant earth location was at least as accurate as the original Avian and did not depend upon expertise of the operator, as the original Avian procedure does. Thus, the automatic Avian procedure eliminated the subjectivity inherent in the interactive landmarking, while reducing the amount of expertise required to perform the navigation task. GRA

N92-13136# Air Force Academy, CO.
SOME RESULTS OF ADDING SOLAR RADIATION PRESSURE FORCE TO THE RESTRICTED THREE-BODY PROBLEM Final Report
Steven C. Gordon Sep. 1991 68 p
(AD-A241397; USAFA-TR-91-10) Avail: NTIS HC/MF A04 CSCL 22/3

This work explores the generation of bounded orbits in the Elliptic Restricted Three-Body Problem (ER3BP), and some of the results of adding the solar radiation pressure force to the ER3BP are presented. The focus is limited to the equilibrium points defined in the Sun-Earth ER3BP. (These equilibrium points are also referred to as libration points or Lagrange points.) The addition of solar radiation pressure to the gravitational and centrifugal force structure alters the locations and conditions for linear stability of the equilibrium points in the Sun-Earth ER3BP. Solar radiation pressure also consequently affects the spacecraft orbits computed near these points. One equilibrium point in this three-body system is located between the Sun and the Earth; orbits near this point are the primary focus for the study of solar effects on the terrestrial environment and are therefore the orbits considered here. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N92-13105*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GOLDSTONE SOLAR SYSTEM RADAR (GSSR)
N. A. Renzetti *In its* Deep Space Network: Mission Support Requirements Oct. 1991 8 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 14B

N92-13834*# Hampton Univ., VA. Dept. of Mass Media Arts.
THE HL-20 AS THE PERSONNEL LAUNCH SYSTEM
Sherilee F. Beam *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 61-67 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

No abstracts in this category.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N92-13137*# National Aeronautics and Space Administration, Washington, DC.
A DECADE ON BOARD AMERICA'S SPACE SHUTTLE
1991 20 p LIMITED REPRODUCIBILITY: More than 20% of this document may be affected by color photographs Original contains color illustrations
(NASA-NP-142; NAS 1.83:142) Avail: NTIS HC/MF A03; 15 functional color pages CSCL 22B

Spectacular moments from a decade (1981-1991) of Space Shuttle missions, captured on film by the astronauts who flew the missions, are presented. First hand accounts of astronauts' experiences aboard the Shuttle are given. A Space Shuttle mission chronology featuring flight number, vehicle name, crew, launch and landing dates, and mission highlights is given in tabular form. Author

N92-13138*# Rockwell International Corp., Downey, CA. Space Systems Div.
PERSONNEL LAUNCH SYSTEM (PLS) STUDY Final Report
Carl F. Ehrlich, Jr. 25 Oct. 1991 280 p
(Contract NAS1-18975)
(NASA-CR-187620; NAS 1.26:187620) Avail: NTIS HC/MF A13 CSCL 22B

NASA is currently studying a personnel launch system (PLS)

approach to help satisfy the crew rotation requirements for the Space Station Freedom. Several concepts from low L/D capsules to lifting body vehicles are being examined in a series of studies as a potential augmentation to the Space Shuttle launch system. Rockwell International Corporation, under contract to NASA, analyzed a lifting body concept to determine whether the lifting body class of vehicles is appropriate for the PLS function. The results of the study are given. Author

N92-13127*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE TRANSPORTATION SYSTEM (STS): EMERGENCY SUPPORT
T. Janoski (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) and L. Nicholson *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N92-13139# Allied-Signal Aerospace Co., Kansas City, MO.
PULSE CODE MODULATION DATA COMPRESSION FOR AUTOMATED TEST EQUIPMENT
T. A. Navickas and S. G. Jones May 1991 7 p Presented at the International Telemetering Conference, Las Vegas, NV, 4 Nov. 1991
(Contract DE-AC04-76DP-00613)
(DE92-000464; KCP-613-4624; CONF-911187-2) Avail: NTIS HC/MF A02

Development of automated test equipment for an advanced telemetry system requires continuous monitoring of PCM data while exercising telemetry inputs. This requirements leads to a large amount of data that needs to be stored and later analyzed. For example, a data stream of 4 Mbits/s and a test time of thirty minutes would yield 900 Mbytes of raw data. With this raw data, information needs to be stored to correlate the raw data to the test stimulus. This leads to a total of 1.8 Gb of data to be stored and analyzed. There is no method to analyze this amount of data in a reasonable time. A data compression method is needed to reduce the amount of data collected to a reasonable amount. The solution to the problem was data reduction. Data reduction was accomplished by real time limit checking, time stamping, and smart software. Limit checking was accomplished by an eight state finite state machine and four compression algorithms. Time stamping was needed to correlate stimulus to the appropriate output for data reconstruction. The software was written in the C programming language with a DOS extender used to allow it to run in extended mode. A 94-98 percent compression in the amount of data gathered was accomplished using this method. DOE

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-13140*# Astro Aerospace Corp., Carpinteria, CA.
CONCEPTS, ANALYSIS AND DEVELOPMENT FOR PRECISION DEPLOYABLE SPACE STRUCTURES
Richard K. Miller, Mark Thomson, and John M. Hedgepeth Jul. 1991 46 p
(Contract NAS1-18567)
(NASA-CR-187622; NAS 1.26:187622; AAC-TN-1163) Avail: NTIS HC/MF A03 CSCL 22B

Several issues surrounding the development of large Precision Segmented Reflector (PSR) designs are investigated. The concerns include nonlinear dynamics of large unruly masses such as the multi-layer thermal insulation of sunshades for instruments such as the precision pointing 20-m-diameter Large Deployable Reflector (LDR). A study of the residual oscillations after bang-bang reorientation maneuvers of a rigid satellite with a string appendage is presented. Application is made to the design of a sunshade (thermal blanket) for the LDE satellite. Another concern is the development of a deployable truss that has minimum structural redundancy (such as the tetrahedral truss) and that can be configured with planar and doubly curved geometries. A kinematically synchronized articulation scheme for a deployable tetrahedral truss is presented. Called the Tetrapac, this truss is currently limited to a planar configuration that has two rings. The final concern is the development and demonstration of hardware that enables astronauts to attach large, cumbersome, and fragile precision reflector segments to an erectable truss structure. This task must be accomplished with a high degree of precision and with relative ease. A design for a Panel Attachment Device (PAD) was developed and manufactured for neutral buoyancy simulations to be performed by LaRC. Author

N92-13141*# Logicon Control Dynamics Co., Huntsville, AL.
TETHERED SATELLITE SYSTEM DYNAMICS AND CONTROL REVIEW PANEL AND RELATED ACTIVITIES, PHASE 3 Final Report, Dec. 1989 - Nov. 1990
Aug. 1991 139 p
(Contract NAS8-35835)
(NASA-CR-184254; NAS 1.26:184254) Avail: NTIS HC/MF A07 CSCL 22B

Two major tests of the Tethered Satellite System (TSS) engineering and flight units were conducted to demonstrate the functionality of the hardware and software. Deficiencies in the hardware/software integration tests (HSIT) led to a recommendation for more testing to be performed. Selected problem areas of tether dynamics were analyzed, including verification of the severity of skip rope oscillations, verification or comparison runs to explore dynamic phenomena observed in other simulations, and data generation runs to explore the performance of the time domain and frequency domain skip rope observers. Author

N92-13142# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
LDEF TEMPERATURE HISTORIES: A SIMPLE THEORY
P. C. Hughes Oct. 1990 75 p
(UTIAS-340; ISSN-0082-5255; CTN-91-60238; AD-B151978L)
Avail: NTIS HC/MF A04

The temperature of a particular area (an experimental test patch) on the surface of the Long Duration Exposure Facility (LDEF) varies with time in a manner that depends on a large number of factors. The direct input from the sun depends on whether LDEF is in sunlight; if in sunlight, on whether the test patch can actually

see sun; and if it can see sun, on the angle of incidence of the sun's radiation. The heat input to the test patch from the rest of the LDEF vehicle also depends on the average temperature of the LDEF vehicle, which in turn depends on its eclipse history. This report examines all these factors and uses a multiple time scale description (corresponding physically to orbital, precessional and annual time scales) to build an understanding of the chief features observed in the flight data. Geometrical, orbital, and thermal models are developed. Numerical calculations based on these models are shown to be be in qualitative agreement (and usually even in semi quantitative agreement) with flight data. Thus all the salient features of the in-orbit temperature data can be explained in terms of the physical phenomena described.
Author (CISTI)

N92-13143*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PARAMETRIC STUDIES OF PHASE CHANGE THERMAL ENERGY STORAGE CANISTERS FOR SPACE STATION FREEDOM
Thomas W. Kerslake 1991 9 p Presented at the International Solar Energy Conference, Maui, HI, 4-8 Apr. 1991; sponsored by the American Society of Mechanical Engineers
(NASA-TM-105350; E-6724; NAS 1.15:105350) Avail: NTIS HC/MF A02 CSCL 22B

Phase Change Materials (PCM) canister parametric studies are discussed wherein the thermal-structural effects of changing various canister dimensions and contained PCM mass values are examined. With the aim of improving performance, 11 modified canister designs are analyzed and judged relative to a baseline design using five quantitative performance indicators. Consideration is also given to qualitative factors such as fabrication/inspection, canister mass production, and PCM containment redundancy. Canister thermal analyses are performed using the finite-difference based computer program NUCAM-2DV. Thermal-stresses are calculated using closed-form solutions and simplifying assumptions. Canister wall thickness, outer radius, length, and contained PCM mass are the parameters considered for this study. Results show that singular canister design modifications can offer improvements on one or two performance indicators. Yet, improvement in one indicator is often realized at the expense of another. This confirms that the baseline canister is well designed. However, two alternative canister designs, which incorporate multiple modifications, are presented that offer modest improvements in mass or thermal performance, respectively. Author

N92-13144# Naval Postgraduate School, Monterey, CA.
ANALYSIS OF A PERTURBATION SOLUTION OF THE MAIN PROBLEM IN ARTIFICIAL SATELLITE THEORY M.S. Thesis
Scott D. Krambeck Sep. 1990 141 p
(AD-A241064) Avail: NTIS HC/MF A07 CSCL 22/3

The development of a universal solution of the main problem in artificial satellite theory has only recently been accomplished with the aid of high powered computers. The solution to this long standing problem is an analytical expression that is similar in form to the two-body solution. An analysis is presented in which the solution is compared with the two-body solution, a proven numerical solution, and actual measured satellite data. The solution is shown to be significantly more accurate than the two-body solution. The theoretical accuracy of the solution is confirmed. The solution compares extremely well with a proven numerical solution for at least 41 orbits with a relative error on the order of J2theta. The solution compares extremely well with measured satellite data for satellites in near Earth orbits. For a satellite in orbit at an altitude of approximately 1000 kilometers, the solution reduces the error of the two-body solution by about 95 percent. For satellites in orbit at semisynchronous and geosynchronous altitudes, the solution reduces the error of the two-body solution by at least 50 percent. The solution is free of singularities and is valid for all eccentricities and inclinations. GRA

N92-13145# Naval Postgraduate School, Monterey, CA.
MEASUREMENT OF THE SPACE THERMOACOUSTIC REFRIGERATOR PERFORMANCE M.S. Thesis
Jay A. Adeff Sep. 1990 241 p
(AD-A241320) Avail: NTIS HC/MF A11 CSCL 22/2

This is the fifth thesis of the Space Thermoacoustic Refrigerator (STAR) project which will be launched aboard the Space Shuttle in 1991 to demonstrate the potential of this technology for cooling satellite electronics and sensors. It describes the design, construction, and testing of the resonator portion of the refrigerator along with its integration with the existing driver and control electronics which were the subject of four previous theses. This resonator incorporates a helium diffusion barrier enabling it to hold ten atmospheres of working gas without leaking. An optimum operating frequency has been chosen based on electroacoustic efficiency measurements and the refrigerator has been allowed to run continuously and autonomously for up to one week at a time to simulate the planned space flight. A lowest temperature of -50 C at a temperature ratio of Tc/Th equals 0.75 and a maximum coefficient of performance relative to Carnot of 14 percent has been obtained. GRA

N92-13146# Analytx Electronic Systems, Inc., Hudson, NH.
GL SPACE EXPERIMENTS Final Report, Apr. 1984 - Mar. 1991
K. B. Fredholm, R. W. Hayes, A. C. Matthews, and P. R. Roth Feb. 1991 69 p
(Contract F19628-84-C-0036)
(AD-A241398; A80808R; PL-TR-91-2056) Avail: NTIS HC/MF A04 CSCL 22/2

This is the final report on a collection of spaceflight hardware instruments and ground support equipment developed for the Geophysics Lab. It includes discussions of the Special Sensors for Ions, Electrons, and Scintillators-2 (SSIES-2) main electronics for the Defense Meteorological Satellite Program (DMSP), Langmuir Probe main electronics for the AF/NASA Combined Release and Radiation Effects Satellite (CRRES), and miscellaneous related equipment. GRA

N92-13147# Boston Coll., Chestnut Hill, MA. Inst. for Space Research.
COMBINED RELEASE AND RADIATION EFFECTS SATELLITE TIME HISTORY DATA BASE Scientific Report No. 1, 1 Jun. 1990 - 31 May 1991
Dennis E. Delorey 31 May 1991 69 p
(Contract F19628-90-K-0028)
(AD-A241583; BC/ISR-91-1; PL-TR-91-2140) Avail: NTIS HC/MF A04 CSCL 12/5

The design, development and implementation factors necessary for the generation of a Time History Data Base (THDB) for the Combined Release and Radiation Effects Satellite (CRRES) mission are described. The CRRES THDB consists of structured, time ordered files of spacecraft sensor data, calibration files, attitude fit, coefficient files and ephemeris files all produced on an orbit-by-orbit and instrument-by-instrument basis. This report describes the make-up of these files and their place in the data base. A brief description of the available parameters is presented. GRA

N92-13148# Aerospace Corp., El Segundo, CA. Technology Operations.
ASSESSMENT OF THE TRIBIOLOGICAL REQUIREMENTS OF ADVANCED SPACECRAFT MECHANISMS Technical Operating Report
Paul D. Fleischauer and Michael R. Hilton 30 Sep. 1991 34 p Previously announced in IAA as A90-14018
(Contract F04701-88-C-0089)
(AD-A241674; TOR-0090(5064)-1) Avail: NTIS HC/MF A03 CSCL 22/2

A survey was conducted of existing technologies for moving mechanical assemblies used in spacecraft applications. The purpose was to identify areas where future requirements for lifetimes in excess of ten years with anticipated speeds, loads, and temperatures might not be satisfied. Some specific

mechanisms, such as momentum/reaction wheels, high speed turbines, pointing and tracking mechanisms, despin mechanisms, and gimbal mechanisms, were identified as areas for potential application of existing but unused technologies. Two major problem areas identified involve boundary regime lubrication and lubricant supply (active or passive) for long life. Areas where substantial, near term improvements appear practical include the use of hybrid bearings, new synthetic fluid lubricants, new bearing retainer materials, and properly designed solid film lubricants. GRA

N92-13149# Photometrics, Inc., Woburn, MA.
MEASUREMENT AND INTERPRETATION OF CONTAMINANT RADIATIONS IN THE SPACECRAFT ENVIRONMENT Final Report, 1 Jun. 1988 - 31 May 1991
I. L. Kofsky, D. L. Rall, and R. B. Sluder 28 Jun. 1991 117 p
(Contract F19628-88-C-0070)
(AD-A241756; PL-TR-91-2174) Avail: NTIS HC/MF A06
CSCL 22/2

Video photographs and spectra of the optical radiations excited by reactions of the energetic exhaust gases from space shuttle's aspect-controlling bipropellant rocket engines with the orbital atmosphere are analyzed. The data were taken with the Air Force Maui Optical Station's cameras and a new imaging spectrograph as these 400 kgf Primary Reaction Control System thrusters operated in ram-wake-perpendicular to the trajectory sequences planned by Geophysics Directorate. Emission originated from a few km parallel and transverse to the symmetry axis of the exhaust; the surface brightness distributions from the firings to windward are well fit by Gaussians; and the total sterances determined by calibration against known stars were in the approximate ration 10 (ram) : 5 (perpendicular) : 1 (wake), showing that the kinetic energy of the combustion products plays a major part in exciting chemiluminescence. Three orders of magnitude less radiation arose from the spacecraft region than from the much larger volume in which the exhaust interacts, from which the hard body appeared physically separated. GRA

N92-13150*# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
MODELING OF SURFACE FLASHOVER ON SPACECRAFT Final Report, 1 Sep. 1986 - 14 Feb. 1990
Mark J. Kushner Dec. 1991 47 p
(Grant NAG3-741)
(NASA-CR-189508; NAS 1.26:189508) Avail: NTIS HC/MF A03
CSCL 22B

A model for predicting the onset of surface flashover discharges (SFDs) in the context of high voltage pulse power modulators was developed and used to investigate mechanisms leading to the onset of SFDs. We demonstrated that it is possible to analyze surface discharges in a manner similar to gas phase discharges using transport coefficients such as the first Townsend coefficient. Our parameterization of various methods to prevent, or at least delay, the onset of SFDs was not particularly successful in that many of the strategies that we investigated do not yield significantly improved performance. The only safe strategy to reduce the occurrence of SFDs is to prevent the dielectric from being charged in the first place. This leads one to consider passive or active schemes which employ the low pressure of attaching gases which flood the surface prior or coincident to pulsing the high voltage apparatus. Our calculations indicate that only small amounts gas (10s Torr effective pressure at substrate) would be sufficient for many of the anticipated applications. If the surface is flooded only when high voltage is applied across the dielectric, the gas consumption would be nominal. Author

N92-13082# Joint Publications Research Service, Arlington, VA.
COMMENTARY ON GRANAT PROJECT
R. Syunyayev *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 16-17 Transl. into ENGLISH from Pravda, Moscow (USSR), 3 Dec. 1989 p 6 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

N92-13865*# Old Dominion Univ., Norfolk, VA. Dept. of Engineering Management.
SPACECRAFT DESIGN OPTIMIZATION USING TAGUCHI ANALYSIS
Resit Unal *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 227-228 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N92-13151*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE ACCELERATION MEASUREMENT SYSTEM DESCRIPTION AND OPERATIONS ON THE FIRST SPACELAB LIFE SCIENCES MISSION
Richard DeLombard and Brian D. Finley (Sverdrup Technology, Inc., Brook Park, OH.) Nov. 1991 28 p
(Contract NAS3-25266)
(NASA-TM-105301; E-6648; NAS 1.15:105301) Avail: NTIS HC/MF A03 CSCL 22A

The Space Acceleration Measurement System (SAMS) project and flight units are briefly described. The SAMS operations during the STS-40 mission are summarized, and a preliminary look at some of the acceleration data from that mission are provided. The background and rationale for the SAMS project is described to better illustrate its goals. The functions and capabilities of each SAMS flight unit are first explained, then the STS-40 mission, the SAMS's function for that mission, and the preparation of the SAMS are described. Observations about the SAMS operations during the first SAMS mission are then discussed. Some sample data are presented illustrating several aspects of the mission's microgravity environment. Author

N92-13152# Northeastern Univ., Boston, MA. Electronics Research Lab.
INSTRUMENTATION, CONTROL AND COMMUNICATION SYSTEMS FOR SOUNDING ROCKETS AND SHUTTLE-BORNE EXPERIMENTS Final Report, 1 Jul. 1987 - 31 Mar. 1991
J. S. Rochefort, Lawrence J. OConnor, Raimundas Sukys, Norman C. Poirier, and Richard L. Morin 2 Jul. 1991 144 p
(Contract F19628-87-C-0128)
(AD-A241272; PL-TR-91-2175) Avail: NTIS HC/MF A07
CSCL 22/2

This report deals with the design, development, fabrication, analysis, and field support of signal processing, control systems and telemetry systems for space vehicles. Sounding rocket programs discussed include BEAR, COLDR, LIFE AND SPEAR I. Shuttle-borne programs include IMPS, IBSS/CIV, and GAS/VIPER. Brief studies were made of airborne optical disk recording systems and packet telemetry. A telemetry system for vibration and shock testing and electro-mechanical release systems were also developed. PL (formerly GL) scientists were provided consultation and assistance in monitoring the EXCEDE-III and SPIRIT-II program. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-13153# European Space Agency, Paris (France).
EUROPEAN SPACE POWER CONFERENCE. VOLUME 1: POWER SYSTEMS, POWER ELECTRONICS, BATTERIES AND FUEL CELLS
James J. Hunt, ed. Aug. 1991 456 p Conference held in Florence, Italy, 2-6 Sep. 1991
(ESA-SP-320-Vol-1; ISBN-92-9092-122-6; ISSN-0379-6566; ETN-91-90065) Copyright Avail: NTIS HC/MF A20; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

Papers on power systems, power electronics, batteries, and fuel cells are presented. The following topics are covered: circuit modeling and analysis; pulse width modulated regulators and resonant converters; power systems for Earth satellites; power system/equipment definition; resonant power conversion; future power/energy system concepts; manned mission power systems; NIH2 battery technology; NiCd battery technology; high voltage technology; deep space power systems; power system simulation; advanced battery systems; new battery technology studies; and fuel cell technology. For individual titles, see N92-13154 through N92-13221.

N92-13154# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
IN-ORBIT PERFORMANCE OVERVIEW OF THE HST SOLAR GENERATOR
B. W. Henson, B. Jackson, and Lothar Gerlach *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 3-8 (For primary document see N92-13153 04-20)
Copyright Avail: NTIS HC/MF A20; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The Hubble Space Telescope (HST) was launched into a 614 km low Earth orbit on 24 Apr. 1990. The HST is a joint NASA/ESA project which has a very ambitious astrometry program with very stringent stability requiremenets to achieve a pointing accuracy of 0.007 arc seconds. ESA provided two major elements towards the project one being the Solar Arrays (SA). The SA's comprise two double roll out wings each with two blankets. Each blanket has five flexible solar panel assemblies which provide more than 5 kW at the beginning of life. Deployment of the arrays and the in-orbit performance both for power and dynamics are addressed. The design and verification program of the second SA are being revised to incorporate changes to improve the integrity and performance. A servicing mission to replace the SA's and other key instruments on the HST is planned for the end of 1993.
ESA

N92-13155# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
POWER SYSTEM PERFORMANCE PREDICTION FOR THE HIPPARCOS SPACECRAFT
R. L. Crabb, J. E. Haines, E. J. Daly, Dermot M. OSullivan, G. Dudley, A. K. Sepers, and H. K. Fiebrich *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 9-18 (For primary document see N92-13153 04-20)
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Following the August 1989 launch of the Hipparcos Spacecraft, a failure in the Apogee Boost Motor (ABM) system resulted in the mission being permanently constrained to the very damaging radiation environment of the geosynchronous transfer orbit. The electrical power implications that faced the Hipparcos Spacecraft at that time are described and the analyses conducted and the performance predictions made are presented. How a mission survival assessment was made for both the critical February/March 1990 eclipse period and for the overall lifetime of the spacecraft, with the aid of a spreadsheet program, is described. Predictions made against the actual results obtained during the February/March 1990 eclipses are compared and from this correlation conclusions for the remaining period are drawn.
ESA

N92-13156# Telefunken System Technik G.m.b.H., Wedel (Germany, F.R.).
ADVANCED CONCEPTS FOR DESIGN AND MANAGEMENT OF THE COLUMBUS NICKEL-HYDROGEN-BATTERIES
Volker Leisten and Uwe Nemsmann *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 19-24 (For primary document see N92-13153 04-20)
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The objectives of and the very stringent requirements imposed on the nickel hydrogen batteries of the Man Tended Free Flyer (MTFF) of Columbus are dealt with. The envisaged technical solutions are presented whereby great importance is attached to mechanical and thermal aspects of the battery design, e.g., the proposed concept of a light weight construction using integrated heat pipes. The battery management tools necessary to achieve the required life time of 5 years under low earth orbit (LEO) conditions are addressed. For the first time, a combination of hardware and, to a large extent, software will be implemented into the onboard battery control.
ESA

N92-13157*# National Aeronautics and Space Administration, Washington, DC.
THE NASA RESEARCH AND TECHNOLOGY PROGRAM ON SPACE POWER: A KEY ELEMENT OF THE SPACE EXPLORATION INITIATIVE
Gary L. Bennett, Henry W. Brandhorst, Jr., and Kenneth L. Atkins (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 25-29 (For primary document see N92-13153 04-20)
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In July 1989, President Bush announced his space exploration initiative of going back to the Moon to stay and then going to Mars. Building upon its ongoing research and technology base, NASA has established an exploration technology program to develop the technologies needed for piloted missions to the Moon and Mars. A key element for the flights and for the planned bases is power. The NASA research and technology program on space power encompasses power sources, energy storage, and power management.
ESA

N92-13158# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
INPUT FILTER DESIGN MADE EASY WITH AVERAGED CURRENT CONDUCTANCE CONTROL
P. Perol and A. Crausaz *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 33-38 (For primary document see N92-13153 04-20)
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The Y model for an average current programmmed buck regulator (also called conductance control) is established, and the conditions of minimum influence of an input filter on the characteristics of the converter in this type of regulation are presented. All these conditions can be reduced to a single one which is that the output impedance of the input filter should be kept low as compared to the input impedance of the converter.

As the conductance control technique is very much design oriented, it is easy to design the converter in such a way that the current loop is damping the input impedance of the converter so much that it is reduced to the output load reflected in the input. A straightforward method to design an input filter with the electromagnetic compatibility requirements is described and some ratios on input filters for MKL capacitors and massively parallel processor cores are given. ESA

N92-13159# Gdansk Technical Univ. (Poland). Inst. of Electronic Technology.

DUALITY CONCEPT LEADS TO A NOVEL SWITCHING CONTROL METHOD

Marek S. Makowski *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 39-45 (For primary document see N92-13153 04-20)

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The concept of a new switching control method of DC-DC current converters is presented. The so-called open circuit switch voltage programming method is dual to the well established current programming one. The basic principle and the resulting advantages of the method are discussed and the general Z type model of the converter is derived. Switch voltage programming control can be easily implemented and in the case of a single cut set current converter tends to make the power stage output behave as a voltage source. ESA

N92-13160# Universidad Politecnica de Catalunya (Spain). Dept. de Ingenieria Electronica.

LARGE SIGNAL MODELLING AND ANALYSIS OF SEPIC CONVERTER USING CONTINUOUS FORMULATION APPROACH

F. Guinjoan, A. Poveda, L. Martinez, L. G. deVicuna, J. Majo, J. C. Marpinard, and M. Valentin (Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse, France) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 47-52 Sponsored by Accion Integrada Hispano-Francesca (For primary document see N92-13153 04-20)

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The continuous formulation approach was developed for large signal modeling and analysis of switching DC-DC converters operating in both continuous and discontinuous conduction mode. This technique can also be applied to the modeling and analysis of a complex power stage such as the SEPIC power converter. As a result, a nonlinear continuous formulation is obtained in the form of block diagram, which can be used to simulate this converter behavior under large signal conditions by means of general purpose programs such as CSMP. ESA

N92-13161# Machine-Building Inst., Severodvinsk (USSR).

SWITCHING DC-DC CONVERTERS WITH MAXIMAL SPEED OF RESPONSE WITH POWER SOURCE ON BASE OF ON-BOARD POWER SUPPLIES IMITATOR

A. S. Iskhakov, Y. N. Kireev, S. G. Obukhov (Academy of Sciences, USSR, Moscow), and A. V. Ushakov *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 53-55 (For primary document see N92-13153 04-20)

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The onboard power supplies imitation in the ground conditions require the power source and the onboard power supply be designed with external characteristics. When the load is powered from the imitator, for the purpose of stable voltage, a voltage controller with high fast response is necessary. One in fast response controller structure, built on the basis of a Pulse Width Modulator (PWM), is described. The fast response controller synthesis was performed by using difference equations, describing the closed loop system dynamics. ESA

N92-13162# Alcatel Espace, Toulouse (France).

CURRENT MODE AND LARGE SIGNAL FEEDBACK COMBINE FOR MINIATURIZED AND EFFICIENT SPACE BORNE RADAR POWER SUPPLY

A. Capel and C. Peyrotte *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 57-62 (For primary document see N92-13153 04-20)

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A state variable feedback controller combining large signal and current mode control is analyzed and detailed for a radar pulsed power supply for space applications. This controller (current control mode state feedback) combines high sampling frequency and bidirectional current low buck cell. Theoretical model and simulation results are compared with the measured performances of an Electronic Power Conditioner (EPC) prototype. ESA

N92-13163# Escuela Tecnica Superior de Ingenieros Industriales, Madrid (Spain). Div. de Ingeneria Electronica.

DESIGN OF A FORWARD ZVS-MRC. PRACTICAL CONSIDERATIONS

J. A. Cobos, J. Arau, J. Sebastian, J. Uceda, R. Lorenzo, and L. R. Castell (Alcatel Standard Electrica S.A., Madrid, Spain) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 63-68 (For primary document see N92-13153 04-20)

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Keeping in mind necessary size reduction in computer equipment, ZVS-MRC (Zero Voltage Switching - Multi Resonant Converters) have taken a strategic place in onboard power supply developments, due to the feasibility of working at high frequencies. The effect in the forward ZVS-MRC performance of the most critical parameters, design guidelinees, and several practical considerations are presented. ESA

N92-13164# Universidad Nacional Autonoma de Mexico, Cuernavaca. Inst. de Investigaciones Electricas.

PULSED LOAD OPERATION IN DC/DC CONVERTERS. A CRITICAL EVALUATION

J. Arau, J. Uceda, J. Sebastian, J. A. Cobos, and F. Aldana (Escuela Tecnica Superior de Ingenieros Industriales, Madrid, Spain) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 69-74 (For primary document see N92-13153 04-20)

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The nonlinear nature of the DC/DC converters makes accurate study of them difficult when using common small signal techniques to linearize the converter about a quiescent operating point in which the nonlinear terms are neglected (assume infinitesimal variations in the averaged state variables). The importance of this assumption appears strongly affected when it is found that it is not possible to ensure the complete large signal stability about the quiescent operating point by designing with small signal techniques when the converter works in a large perturbation environment of the state variables. Using large signal modeling techniques, a critical evaluation about a pulsed load operation on the basic DC/DC converters is presented. The necessary constraints which use small signal techniques to study the transient response with acceptable accuracy in typical large signal operation are explored. ESA

N92-13165# TRW Space Technology Labs., Redondo Beach, CA.

FURTHER PROGRESS IN IMPROVING THE EFFICIENCY OF HIGH-FREQUENCY SATURABLE-CORE OUTPUT REGULATORS

Horacio E. Gavira *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 77-82 (For primary document see N92-13153

04-20)
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Refinements on the design of high frequency saturable core output regulators are discussed. Improved passive techniques to minimize the detrimental effect of parasitic reset are introduced. The new breakthrough improves the efficiency and utilization of saturable core output regulators, or magamp post regulators, in ways which the performance and efficiency remain optimal even when the power converter is working under conditions of minimum input voltage. The results show an improvement of more than 18 percent on the utilization of magamp post regulator operating at 5000 kHZ. This is achieved by a simple magnetic timer element that provides a brief, controlled surge of current that balances, on cycle by cycle basis, the rectifier's recovered charge thus ensuring that the volt seconds capability of the saturable reactor is maximized. A computer model is created that shows an excellent match between analysis and test results. This model clearly identifies several circuit characteristics which add valuable information to the overall findings. ESA

N92-13166# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
LOW IMPEDANCE PWM SWITCH AND SOLID STATE SWITCH
M. MartinAlfonso and Inigo SegurayDiazdeEspadas *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 83-88 (For primary document see N92-13153 04-20)
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Two of the main concerns in the design of any of the components of a spacecraft subsystem are its mass and its size. That is why the use of any magnetic element has to be justified by a gain in the efficiency of the subsystem and has to be avoided as long as the efficiency is not degradated. This is applicable to protection devices such as Limit Cycle Current Control (LCCC) and the Solid State Power Controller (SSPC) type. The advantage of LCCC type current limiter is the capability of poviding current limitation indefinitely while the SSPC has a limited current capability in order to keep the device operation in its rated temperature. Two different types of current limiters which are actually the state of the art, the Pulse Width Modulated (PWM) switch and the SSPC, are dealt with. ESA

N92-13167# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
A NEW NON-DISSIPATIVE SWITCH
Alan H. Weinberg and Inigo Segura *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 89-94 (For primary document see N92-13153 04-20)
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In recent years, there has been a trend towards an ever increasing frequency for switching power regulators to obtain lower volume, mass, and wider regulation bandwidth. The introduction of regulated quasi-resonant (QR) techniques to achieve this aim has not fulfilled its initial promise. There is also some doubt about the suitability of this technique for power levels above several hundred watts. In addition, it is a difficult task to satisfy the requirements regarding the stability of operation of any regulators in a satellite power systems using QR techniques. On the other hand, the well established Pulse Width Modulated (PWM) technique cannot be operated at high frequency without the penalty of high switching loss. A technique to overcome the switching losses of a PWM power stage and which therefore enables it to operate at high frequency is described. ESA

N92-13168# LABEN Ferranti International, Vimodrone (Italy).
TOPOLOGY AND CONTROL OPTIMIZATION OF ON-BOARD POWER SUPPLIES BY COMPUTER-AIDED MODELING
E. Banfi, P. Maranesi (Politecnico di Milano, Italy), and G. F. Volpi *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 95-98 (For primary document see N92-13153 04-20)
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A variable topology multi-output switching cell for onboard satellite applications is analyzed with the aid of the program FREDOMSIM. The cell is connected to an LC input filter and realizes a fourth order DC/DC converter, which is modeled as a unique system. Dynamic characterizations, provided by the automatic modeling tool, allow the comparison of the performances of the different topologies and of the possible conduction modes and control modes on the basis of frequency response plots and of loci of poles and of zeros. Some steps of the design optimization drawn by computer aided modeling are illustrated. ESA

N92-13169# Surrey Univ., London (England). Dept. of Electronic and Electrical Engineering.
AN EFFICIENT STEP-UP/DOWN DC PREREGULATOR FOR SPACE APPLICATIONS
T. G. Foley and D. C. Hamill *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 99-105 Sponsored by RAE (For primary document see N92-13153 04-20)
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When a DC-DC converter is fed by a widely varying input voltage, it is sometimes advantageous to employ a preregulator rather than include this function in the main converter. A suitable preregulator topology consists of a standard buck converter and boost converter in cascade, with a shared choke. The circuit is capable of both step up and step down operations, and can have high efficiency and low choke mass. An experimental preregulator power circuit employing MOSFET's switching at 100 kHz accepts an input voltage of 25 to 100 V and delivers 50 V at 3.5 to 14A. Its measured efficiency is 94 to 98 pct., depending on input voltage and output current. ESA

N92-13170# Kobe Univ. (Japan). Dept. of Electrical Engineering.
A NOVEL SOFT-SWITCHING SINEWAVE PWM CONVERSION CIRCUIT AND SYSTEM WITH HIGH-FREQUENCY LINK
H. Yonemori, K. Muneto, A. Chibani, and M. Nakaoka *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 107-112 (For primary document see N92-13153 04-20)
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A newly improved sinewave CVCF Power Conversion conditioning System (PCS) based upon a high frequency (HF) isolated AC link cycloconversion circuit using softswitching phase shifted pulse width modulation and instantaneous voltage regulation schemes is presented. This advanced circuit topology of voltage clamped quasi-resonant (QR) switch, which comprises two cascaded power conversion stages operating under the principle of Zero Voltage Switching (ZVS), is introduced in order to minimize switching losses, device stresses, electromagnetic interference noise, and remove a complicated HFAC snubber. A considerable improvement in power density output performance and power conversion efficiency is achieved employing a HF link soft switched cycloinversion concept. Its working principle is described including control processing strategy. A voltage clamped QR sinewave PSM HFAC inverter is analyzed under load dependent current source model and its approximate circuit design approach is discussed theoretically. The computer aided simulating and experimental results are illustrated and evaluated for UPS and utility lineinterfaced power supply systems. ESA

N92-13171# Alcatel Espace, Toulouse (France).
POWER DISTRIBUTION SYSTEM FOR A SYNTHETIC APERTURE RADAR
A. Capel and A. Batle *In* ESA, European Space Power

Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 115-129 (For primary document see N92-13153 04-20)
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A spread sheet software was applied for the selection of the electrical architecture of a spaceborne synthetic aperture radar power supply using an active array antenna. Mathematical models for the evaluation of the power losses and mass of the power supply modules were developed and a tradeoff analysis is detailed for two typical architecture concepts based on decentralized DC/DC and hybrid DC/AC electrical distributions. ESA

N92-13172# Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan. Space Div.
THE SAX ELECTRICAL POWER SUBSYSTEM
P. Galantini and M. Lombardo *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 131-136 (For primary document see N92-13153 04-20)
Copyright Avail: NTIS HC/MF A20; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The low Earth orbit operation of the SAX Spacecraft imposes severe constraints on the power subsystem design and mainly on the battery management. The battery management approach is driven by the need to withstand the 14.000 charge/discharge cycles throughout the satellite operative lifetime. Batteries monitoring and automatic protections are designed to avoid any stress on the batteries and to allow autonomous operation to the power subsystem due to the short satellite ground link time during the orbit period. The configuration of the electrical power subsystem and design criteria adopted to satisfy the requirements imposed by the SAX mission are described. ESA

N92-13173*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE SMALL EXPLORER POWER SYSTEM ELECTRONICS
G. Dakermanji, U. Carlsson, D. Temkin (Fairchild Space Co., Germantown, MD.), H. Culver, G. E. Rodriguez, and A. Ahmad *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 137-142 (For primary document see N92-13153 04-20)
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The power system electronics for the NASA Goddard Space Flight Center Small Explorer Satellites are intended to satisfy various planned missions. The selected topology is a direct energy transfer (DET) system with the battery connected directly to the bus. The shunt control technique is a linear sequential full shunt which provides a simple solar array interface and can support both 3 axis stabilized and spinner satellites. In addition, it can meet stringent electromagnetic interference requirements which are expected on some Small Explorer Missions. The Power Systems Electronics (PSE) performs battery charge control using both temperature compensated charge/discharge ratio ampere hour integration and voltage-temperature control. The PSE includes all the circuits needed to perform telemetry and command functions using an optical MIL-STD-1773 interface. ESA

N92-13174# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ESA POWER STANDARD
H. Spruijt, P. Perol, and A. Hogsholm (Danish Space Research Inst., Lyngby.) *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 145-150 (For primary document see N92-13153 04-20)
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The ESA Power standard, its objectives and its capability are introduced. The standard contains two parts: (1) general requirements containing only general statements and formulas; and (2) the template of the specification format, which shall be updated during the development phases of a satellite application. This standard is supported by a rationale explaining the parameters specified in the standard together with example cases. ESA

N92-13175# Universidad Politecnica de Barcelona (Spain). Industrial Electronics Group.
ALTERNATIVE PHOTOVOLTAIC ENERGY CONTROL BY 16 BIT MICROPROCESSORS: PERFORMANCES AND TIME CONSTRAINTS
Josep Bordonau and Juan Peracaula *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 151-156 (For primary document see N92-13153 04-20)
(Grant CICyT-87-0193)
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Eesults obtained with an experimental system using microcomputer control of a DC/DC switched mode power converter fed from photovoltaic solar panels are presented. The control system maintains a constant output voltage regardless of the illumination and charge variations. The digital control presents the advantages of: avoiding derivation of reference values; the ease of controller parameter adjustment and facility to cover a large number of working regimes of photovoltaic panels; and the DC/DC power converter. A Proportional Integral Derivative (PID) algorithm is used for the controller. Optional offline pre-use test, PID parameter adjustment and output voltage fixing are very easy to carry through by means of an externally connectable terminal keyboard. ESA

N92-13176# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
PROTECTION CONCEPTS USED IN SPACECRAFT POWER SYSTEMS
Dermot Levins *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 157-162 (For primary document see N92-13153 04-20)
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Some of the protections used in spacecraft power system designs or which have been forgotten or rejected on the assumption that they were unnecessary are addressed. Protection is one of the more critical features of any reliable design, unfortunately its omission is often only recognized in hindsight and in spacecraft applications this can be catastrophic. ESA

N92-13177# Kobe Univ. (Japan). Dept. of Electrical Engineering.
ZERO-VOLTAGE SOFT-SWITCHED PWM HIGH-FREQUENCY AC-LINK DC-DC CONVERTERS INCORPORATING SATURABLE REACTOR-ASSISTED CAPACITIVE LOSSLESS SNUBBER TOPOLOGY FOR DISTRIBUTED POWER SUPPLY SYSTEMS
S. Nagai, T. Yamamoto, M. Nakaoka, and S. Hamada (Sansha Electric Mfg. Co. Ltd., Japan) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 165-171 (For primary document see N92-13153 04-20)
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A new constant frequency soft switching phase shifted mode Pulse Width Modulated (PWM) DC-DC power converter topology suitable for high power applications, which incorporates two phase half bridge high frequency inverter and saturable reactor in series with rectifier, is described. The newly proposed high power density converter with high frequency isolation link is capable of accomplishing an efficient and reliable Zero Voltage Switching (ZVS) under a considerable variation range from no load to full load and a wide voltage regulation range. Its steady state operating

characteristics are evaluated and discussed through computer aided simulation which are required for an optimum converter design and experimental results. ESA

N92-13178# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ZERO VOLTAGE SWITCHING CONVERTER TECHNIQUES
Dermot M. OSullivan and Inigo Segura *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 173-178 (For primary document see N92-13153 04-20)
Copyright Avail: NTIS HC/MF A20; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

A common problem associated with the majority of isolating DC/DC converters and DC/AC inverters (normally with power stages designed to drive a power transformer) is the undesired behavior of the parasitic parameters of the transformer and in particular the loading effect of the interwinding and switch capacitances. The consequence of driving a converter with a significant parasitic capacitance is that the inverter must provide high peak currents to reverse the voltage across these capacitors and hence, results in high switching losses in the inverter power stage. The effect is of major importance for high frequency and high voltage ratio applications. A Zero Voltage Switching (ZVS) method for the soft switching of classical converters is described and the basic idea is extended to the general concept of ZVS for any converter or regulator power stage employing inductive elements. ESA

N92-13179# Birmingham Univ. (England). School of Electronic and Electrical Engineering.
A COMPARISON OF PHASE-SHIFT CONTROLLED RESONANT AND SQUARE-WAVE CONVERTERS FOR HIGH POWER ION ENGINE CONTROL
A. J. Forsyth, P. D. Evans, M. R. Al-Mothafar, and K. W. E. Cheng *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 179-185 (For primary document see N92-13153 04-20)
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Two alternative power converter topologies which are under consideration for the constituent modules of the UK-25 ion thruster main beam supply are compared. Both converter topologies operate at fixed frequency and with zero voltage switching conditions. The first is a square wave topology, while the second is a series resonant converter. The converter operation and characteristics are described, the zero voltage switching load range is quantified and practical results are included to illustrate the attainable performance. ESA

N92-13180# Alcatel Kirk ASD A/S, Ballerup (Denmark).
SMALL SIZE DC/DC CONVERTER FOR REGULATED POWER BUSES
P. T. Frederiksen, M. Nymand, O. S. Seiersen, and Alan H. Weinberg (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 187-190 (For primary document see N92-13153 04-20)
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A standardized board mountable power supply module is presented. The converter is optimized for regulated power buses using a low headroom linear regulator followed by a fixed frequency multiresonant zero voltage zero current switching converter. The converter has three output voltages featuring extremely good cross regulation obtained by a new patented distributed tuning technique. Other features are: very low switching noise, inherent input short circuit protection, no overvoltage failure mode, active inrush current limiting, power density 10 W/cubic in. using space qualified or qualifiable components. ESA

N92-13181# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
PARALLEL POWER REGULATION OF A CONSTANT FREQUENCY, ZV-ZC SWITCHING RESONANT PUSH-PULL
L. Ghislanzoni *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 191-198 (For primary document see N92-13153 04-20)
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A resonant push-pull stage topology which merges the Zero-Voltage Zero Current (ZV-ZC) switching principle with a fixed frequency Pulse Width Modulted technique, acting just on part of the transferred power, in order to achieve regulation and first order behavior, is proposed. As a steady state regulation is carried out just on part of the transferred power, this topology is best suited for utilization with a regulated bus, i.e., if regulation can be achieved handling just 10 percent of the transferred power some 90 percent efficiency, then the effective efficiency of the preregulator function is 99 percent. ESA

N92-13182# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
PRIMARY POWER CONVERSION IN THE SPACE STATION FREEDOM
Henry Lee, C. Q. Lee, S. Sooksatra, K. Siri, and T. F. Wu (Illinois Univ., Chicago.) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 199-204 (For primary document see N92-13153 04-20)
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The overall system requirements of the power converter system designed to supply the power needed for the station loads are presented. The converter module used for this application is the current fed push pull converter. The converter analysis is presented. This includes the large signal, small signal closed loop control. Simulations and experimental results are used to confirm the theoretical work. The prototype unit was developed by using specially designed power components, which exhibits power conversion efficiency of more than 92 percent. In the closed loop control, small signal analysis for the converter using the state space averaging method is presented. The interaction between the line filter and the power stage input impedance in the closed loop system was also investigated. ESA

N92-13183# Santa Catarina Univ., Florianopolis (Brazil).
A FAMILY OF HALF-BRIDGE PWN ZERO-VOLTAGE SWITCHING CONVERTERS, EMPLOYING SWITCHED CAPACITOR SNUBBER
Ivo Barbi and Helio Leaes Hey (Universidade Federal de Uberlandia, Brazil) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 205-210 (For primary document see N92-13153 04-20)
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A class of soft switching half bridge DC-DC Converters regulated by Pulse Width Modulation (PWM), where the transistors commutate at zero voltage are introduced. The full bridge DC-DC Converter, because of three level modulation, can be regulated by PWM with ZVS (Zero Voltage Switching), employing the phase shift technique. However, the same technique is not applicable to the half bridge converters because each commutation cell can provide only two voltage levels. In this case, a switched capacitor snubber is proposed to allow ZVS and PWM simultaneously. Principle of operation, theoretical analysis, commutation analysis, design procedure and example and experimental results of the new class of converters are presented. It is believed that the proposed technique is suitable for high power isolated multi output power supplies applications. ESA

N92-13184# Technische Univ., Munich (Germany, F.R.). Inst. C for Thermodynamics.
POWER CONVERSION UNITS FOR SOLAR-DYNAMIC SPACE POWER GENERATION
W. Zoerner and J. Blumenberg *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 213-218 (For primary document see N92-13153 04-20)
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The future low Earth orbit infrastructure (manned and unmanned) will demand considerably higher electric power supplies as compared to past applications. The power conversion unit is of major influence within the overall power system. The power conversion unit's qualities decide on the mass and the size/efficiency of the power system. After an introduction to the power conversion units and a preoptimization, a tradeoff was carried out, identifying a free piston Stirling engine based power system as the best future choice and an Organic Rankine Cycle based power system as a good near term experiment alternative. ESA

N92-13185# Wisconsin Univ., Madison. Applied Superconductivity Center.
SUPERCONDUCTIVE MAGNETIC ENERGY STORAGE (SMES) FOR SPACE APPLICATIONS
Y. M. Eyssa, R. W. Boom, X. Huang, M. A. Hilal, M. K. Abdelsalam, L. O. El-Marazki, and M. J. Superczymski (David Taylor Research Center, Annapolis, MD.) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 219-224 (For primary document see N92-13153 04-20)
(Contract N00167-87-K-0095)
Copyright Avail: NTIS HC/MF A20; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

SMES conceptual designs of solenoids and toroids for space use are developed and assessed as to: storage efficiency versus weight and volume, power capability, cooling requirements; and storage system reliability. Innovative uses of light weight structures and conductors are explored. A credible solenoid design demonstrates energy/weight densities comparable to batteries and power/weight densities and lifetimes far superior to batteries. Example systems described are: a rippled solenoid storage unit sized to fit in the Space Shuttle, and toroidal or multisolenoidal units with minimum external fields. ESA

N92-13186# Texas A&M Univ., College Station. Power Electronics Lab.
POWER ELECTRONIC TECHNIQUES FOR HIGH-POWER DYNAMIC SPACE SYSTEMS
M. Ehsani and J. Hansen *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 225-230 (For primary document see N92-13153 04-20)
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Increasing demand for high power long duration space power systems has led to a renewed investigation of using nuclear reactor sourced power systems employing dynamic power conversion. Dynamic power converters, in turn, can employ several types of electrical generator/regulation systems. The synchronous wound field (WF) rotary generator and the synchronous permanent magnet (PM) rotary generator are identified as the best machines to use for dynamic generation. Advanced AC-DC converters will maintain unity power factor at the WF generator terminals and for the PM generator, unity power factor at the air gap is maintained. Results of simulations using a computer model are reviewed. Discussions of the implementation of generator rectifier architectures are given. ESA

N92-13187# National Space Development Agency, Ibaraki (Japan).
DESIGN OF THE JAPANESE EXPERIMENT MODULE ELECTRICAL POWER SYSTEM
M. Komatsu, T. Gohnai, and S. Kitakata (Mitsubishi Electric Corp., Tokyo, Japan) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 233-238 (For primary document see N92-13153 04-20)
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The design of the Japanese Experiment Module's (JEM) electric power system is discussed including the key design goals of electrical performance, power distribution system, power management, and control. Tradeoff studies were conducted for many of the more important JEM electric power system design decisions. The results of the tradeoff studies should be reflected in the first development model of the Power Distribution Unit (PDU). ESA

N92-13188# Telefunken System Technik G.m.b.H., Wedel (Germany, F.R.).
COMPUTER SIMULATION OF COLUMBUS 4-DOMAIN 120 VDC MAINBUS REGULATION
Addi Schreger *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 239-244 (For primary document see N92-13153 04-20)
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A realistic computer simulation of the extent and complexity Electrical Power Systems (EPS) of the Columbus Man Tended Free Flyer (MTFF) is demonstrated. Special interest is given to the calculation of the mainbus impedance when operating in 4 different domains of the nonlinear sequential switching shunt regulator, the linear external power regulator, battery charge regulator and battery discharge regulator. The determination of the stability of the EPS control loops is of great importance. The impacts of failure modes and dead bands are shown. The results of these investigations support hardware design and test. ESA

N92-13189# Alenia Spazio S.p.A. (Italy).
SIMULATION OF LARGE POWER DISTRIBUTION SYSTEM BEHAVIOR UNDER LOAD SWITCHING CONDITIONS: THE COLUMBUS ATTACHED LABORATORY EPDS CASE
Giorgio Miniotti, Giuseppe Gervasio, and Leonardo Schiavone *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 245-255 (For primary document see N92-13153 04-20)
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The prediction of phenomena of transients is of particular concern when a large amount of power is managed. The identification, during the design phase, of potential out of limits behavior is mandatory and, considering the complexity of the Electrical Power Distribution System (EPDS) of the Columbus Attached Laboratory, the need for computer simulations is evident. The EPDS architecture consists of a star distribution configuration to supply the payloads and a mixed one (bus plus star) for subsystem power (1990 proposal configuration). The lines are simulated by lump parameter models while the on/off switching function, which is implemented by Solid State Power Controllers'(SSPCs), is simulated with a nonlinear voltage generator driven by the current source. Within the constraints imposed by the modeling of lump parameters, the analysis of EPDS transient voltages and currents was performed. The following cases are considered: short ciruit; on/off switching of different loads in each analysis; maximum voltage transient; transient time duration; and maximum voltage swing. ESA

N92-13190# Etudes Techniques et Constructions Aerospatiales, Charleroi (Belgium).
THE HERMES SPACEPLANE POWER SUBSYSTEM CONDITIONING AND DISTRIBUTION
A. Duchene and B. Lacore (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference.

Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 257-263 (For primary document see N92-13153 04-20)
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The power subsystem of the Hermes Spaceplane is presented and the architecture resulting from several tradeoffs is described. The last status of the phase 2 proposal (end of 1990) is given. The Electrical Power Distribution (EPD) subsystem is dealt with. A preliminary presentation of the breadboard of the power control and distribution unit is also discussed. ESA

N92-13191# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SAFT SECOND GENERATION NI-H2 CELL IN THE 40Ah-100Ah RANGE FOR GEOSTATIONARY APPLICATION
J. Verniolle, T. Jamin, and D. Paugam (Societe des Accumulateurs Fixes et de Traction, Romainville, France) *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 267-272 (For primary document see N92-13153 04-20)
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The status of the development of SAFT improved nickel hydrogen (Ni-H2) technology in the range 40 Ah to 100 Ah is presented. Initiated after the successful qualification of the SAFT 50 Ah to 50 Wh/kg technology, this development was aimed at a cell of extended capacity range with improved mass and cost performances. To meet the stringent safety requirements imposed by ESA, specific considerations were given to the design of the pressure vessel, its fracture mechanics analysis and its characterization versus the hydrogen embrittlement effect. While retaining the major design features that guarantee the cycle life of SAFT Ni-H2 technology, a dual stack configuration in a standard 3.5 inch diameter, hydroformed vessel was defined, analyzed and validated. An energy density of 59 Wh/Kg was achieved for an actual capacity of 100 Ah. ESA

N92-13192# Societe des Accumulateurs Fixes et de Traction, Romainville (France). Space Dept.
FRENCH TECHNOLOGY IN NiH2 CELL AND BATTERY IN GEO SATELLITE FOR THE PRESENT DECADE
B. Lacout and D. Paugam *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 273-277 (For primary document see N92-13153 04-20)
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Work carried out on cell general design, performance and qualification level in the new approach for battery development, is described. For Geosynchronous Earth Orbit (GEO) and low Earth orbit satellite programs the NiH2 cells offer an optimized solution to power demands for the present decade. This NiH2 battery developed with a multiplatform approach allows the project requirements to be fulfilled with low cost and reduced delivery time. The definition has already been successfully validated on a structural and thermal model battery. The qualification will be achieved on the two extremes of the battery range: 27 VHS90CM (27 cells of 90 Ah) and 12VHS50CM (12 cells of 50 Ah). This work will be completed by early 1992. ESA

N92-13193# Eagle-Picher Industries, Inc., Joplin, MO.
EUTELSAT 2 NICKEL-HYDROGEN STORAGE BATTERY SYSTEM DESIGN AND PERFORMANCE SUMMARY
Phillip Duff *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 279-284 (For primary document see N92-13153 04-20)
Copyright Avail: NTIS HC/MF A20; ESA, EPD, Noordwijk, Netherlands, HC 120 Dutch guilders (2 vols)

The Eutelsat 2 nickel hydrogen battery system was designed to supply electrical energy for prelaunch, launch, transfer and geosynchronous orbit including solar eclipses and peak load operations. The nickel hydrogen battery system was selected to support this mission primarily due to long life, high energy density characteristics and sucessful spaceflight heritage. Details of the cell and battery design and battery electrical performance are outlined and results of qualification/acceptance testing are summarized. ESA

N92-13194# Aerospace Corp., El Segundo, CA. Electronics Technology Center.
MODELING PERFORMANCE DEGRADATION IN NICKEL HYDROGEN CELLS
Lawrence H. Thaller and Thomas P. Barrera *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 285-290 (For primary document see N92-13153 04-20)
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With the increasing use of nickel hydrogen cells and batteries, degradation models and cycle life predictions can be valuable if they are valid. Previous studies of the expansion characteristics of nickel electrodes, as well as early efforts to predict cycle life as a function of depth of discharge are reviewed. The results of these earlier studies are used to suggest a more accurate degradation model for nickel electrodes. Preliminary experimental studies were focused on electrodes of the type used in typical flight hardware. The objective is to explore the stiffness of electrodes as they are cycled to different depths of discharge and different concentrations of KOH. Electrodes of different plaque strengths, loading levels of active material, and amount of cobalt additives will eventually be investigated. The ultimate goal is to more accurately predict life cycle of a cell as affected by design parameters. ESA

N92-13195# Centre National d'Etudes Spatiales, Toulouse (France).
RECENT PROGRESS IN THE FIELD OF NICKEL AND CADMIUM ELECTRODES AIMED AT MAKING HIGH SPECIFIC ENERGY Ni-Cd AND Ni-H2 BATTERIES
G. Bronoel, N. Tassin, T. Potier, S. Besse, and R. Rouget (Sorapec, Fontenay sous Bois, France) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 293-295 (For primary document see N92-13153 04-20)
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Recent progress in the manufacture of new collectors for nickel and cadmium electrodes is reviewed. High specific energy NiCd and NiH2 batteries can be realized with such collectors (nickel foam or felts). Cadmium electrodes prepared with a high porosity nickel foam, have a good ability for oxygen recombination and an appropriate doping treatment leads to high yields (90 percent). Nickel electrodes are prepared with a fibrous nickel collector electrochemically impregnated and also have high yields (90 percent). ESA

N92-13196# Furukawa Electric Co. Ltd., Tokyo (Japan). Space and Aeronautical Div.
LIFE CHARACTERISTICS OF NI-Cd BATTERY CELLS FOR SCIENTIFIC SATELLITES
Y. Ishikawa, K. Fujita, M. Hirose, M. Koubata, M. Kudoh, K. Matsui, K. Murata, K. Saitoh, M. Tajima, and K. Takahashi (Tokyo Univ., Japan) et al *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 297-302 (For primary document see N92-13153 04-20)
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Nickel cadmium battery cells have been used as a secondary power source for scientific satellites in Japan. Battery cells which have a capacity of 2 to 19 Ah were mounted and worked well in orbit during the mission life of each satellite. The ground life test and flight data of the Prototype Model (PM) battery cells and

onboard cells with 19 Ah capacity for the 11th scientific satellite GINGA are described. It is confirmed that the NiCd PM battery cells for GINGA have life characteristics of more than 25,000 charge/discharge cycles at 25 percent of depth of discharge. Therefore, it can be presumed that the PM cells have characteristics providing more than 45 years of life in low Earth orbit. ESA

N92-13197# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Electrical Systems Dept.

UPDATE ON LOW-EARTH ORBIT NICKEL CADMIUM BATTERY LIFETIME TESTING

B. Hendel, G. Dudley, and G. Gave (Centre National d'Etudes Spatiales, Toulouse, France) *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 303-308 (For primary document see N92-13153 04-20)

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Within the joint CNES-ESA ELAN program, which has been running for six years, nickel cadmium batteries are cycling under various Low Earth Orbit (LEO) conditions. No sudden cell failures have occurred, but all cells in the battery subjected to the most severe conditions (25 C, 40 pct. depth of discharge) have reached the end of life criterion for end of discharge voltage. Capacity retention was poor and teardown analysis revealed a loss of negative plate capacity and extensive cadmium migration into the separator. The remaining 20 batteries continue cycling. Initial lifetime expectations have been considerably surpassed. The so called memory effect is very evident and long term as well as short term beneficial effects of both shallow and deep reconditioning are evident. In the absence of reconditioning, memory effects are likely to determine the useful lifetime of a battery on board a spacecraft. In the case of a battery subjected to a simulated ERS-1 spacecraft load profile, reconditiong after two years has allowed a second two year period of life to be sustained. This has important implications for the management of batteries for future LEO missions such as the Columbus Polar Platform. ESA

N92-13198# Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan. Space Div.

NEW EPC FOR 130W RF TWTA FOR KU-BAND DBS APPLICATIONS

M. Gambarara and L. Ceruti *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 311-316 (For primary document see N92-13153 04-20)

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A new Electric Power Converter (EPC) developed in the frame of an ESA contract aimed at the design, manufacture and qualification of a 130W RF Travelling Wave Tube Amplifier (TWTA) for Direct Broadcast Satellites (DBS) applications is presented. The main objective was the improvement of the most important characteristics requested to today's EPCs, in particular the mass, the efficiency and the cost. The EPC was designed to interface both regulated and unregulated buses in a range from 27 to 50 V with an efficiency measured on the breadboard of 91.8 pct. at 43 V MB. The unit is able to operate also during critical pressure conditions; in spite of the penalities that this performance gives (the complete potting of the high voltage circuits is needed), the mass has been maintained below 2800 grams. ESA

N92-13199# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

EXPERIMENTAL PARTIAL DISCHARGE DETECTION EQUIPMENT FOR DC AND DC RAMP HIGH VOLTAGE TESTING

J. C. J. Eeman *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 317-322 (For primary document see N92-13153 04-20)

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The facility for detection and recording of partial discharges which occur in DC and DC ramp and ramp plateau high voltage testing is described. Discussed topics are the general layout of the facility, the required shielding, the selection criteria for critical system components, a newly developed partial discharge detector with a wide logarithmic scale, an input circuit adaptable to various specimen capacitances and an output voltage waveform optimized for recording on instrumentation like a pulse height analyzer and/or a strip chart recorder. ESA

N92-13200# Nippon Telegraph and Telephone Public Corp., Tokyo (Japan). Applied Electronics Lab.

A HIGH-EFFICIENCY AND LIGHT-WEIGHT TWT POWER SUPPLY FOR A COMMUNICATIONS SATELLITE

Takashi Yamashita, Satoshi Ohtsu, Katsuhiko Yamamoto, and Toshiyuki Sugiura *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 323-328 (For primary document see N92-13153 04-20)

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The weight of Traveling Wave Tube (TWT) power supply can be reduced by increasing the switching frequency. It is however difficult to raise the switching frequency since there is much switching loss caused by current charging and discharging to/from the stray capacitance of a high voltage transformer. A new method for designing high voltage transformers and choke coils to reduce power loss caused by tranformer stray capacitance is described. With the method, the switching frequency of a TWT power supply can be raised to 200 kHz from 20 kHz without increasing power loss. Furthermore, a heater inverter is simplified and surface mount technology is applied to a control circuit and the heater inverter. As a result, a newly developed TWT power supply weighs about 30 percent of the conventional power supply. ESA

N92-13201# Aston Univ., Birmingham (England). Dept. of Electrical Engineering and Applied Physics.

THE THREAT OF PARASITIC ELECTRON EMISSION IN HIGH-VOLTAGE POWER AND COMMUNICATION SYSTEMS OPERATING UNDER SPACE CONDITIONS

R. V. Latham, N. S. Xu, A. E. D. Heylen, and V. Postoyalko (Leeds Univ., England) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 329-334 (For primary document see N92-13153 04-20)

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Experimental studies have established that at fields exceeding approximately 20 MV/m, the insulation of high voltages in both a vacuum and gas environment is ultimately limited by the surface state of electrodes. Of particular significance are such factors as their preparation procedure, cleanliness, and level of oxidation. ESA

N92-13202# Eidgenoessische Technische Hochschule, Zurich (Switzerland). High Voltage Lab.

PARTIAL DISCHARGE MEASUREMENTS TO DETERMINE LONG-TERM CHARACTERISTICS OF THIN EPOXY PLATES UNDER CYCLIC STRESS

Hans-Juerg Weber, Kurt Lehmann, Peter Bochsler, and Josef Fischer (Bern Univ., Switzerland) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 335-341 (For primary document see N92-13153 04-20)

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For the investigation of suprathermal solar particles a High Voltage (HV) electrostatic analyzer was developed for use onboard the Solar and Heliospheric Observatory (SOHO) spacecraft. The high and variable electric field strengths at the insulating parts of

the analyzer demand an extensive HV test program to ensure reliable operation during the projected lifetime of the spacecraft of two years. To perform such tests a custom made partial discharge measuring system was constructed. A newly developed software package was utilized for automatic detection, protocoling and graphics presentation of small partial discharges. A special feature of the system is its flexibility. Thus the system can be useful for numerous nonstandard applications in space projects.
ESA

N92-13203# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
CONDUCTANCE CONTROL WITH A BOOST REGULATOR FOR A HIGH VOLTAGE POWER CONDITIONER FOR A TWTA
I. Arens and F. Tonicello (Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Padua.) *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 343-350 (For primary document see N92-13153 04-20)
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The current controlled boost pulse width modulated regulator for the Traveling Wave Tube Amplifier (TWTA) is analyzed in terms of current and voltage loops, input and output impedance, and input voltage susceptibility. The analysis is performed in small signal approximation using the time averaging method. The duty ratio generator is based on a comparison of the inductor current with a double sided sawtooth without a storage device. A computer evaluation of the full transfer functions is given and simpler expressions are derived by further approximations, displayed by inspection of poles and zeroes and proposed for converter synthesis.
ESA

N92-13204*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE EVOLUTION OF POWER MANAGEMENT ARCHITECTURE FOR MISSIONS TO THE OUTER PLANETS
R. C. Detwiler *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 353-357 (For primary document see N92-13153 04-20)
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Outer planet spacecraft have unique requirements that differentiate them from inner planet and Earth orbiter spacecraft. To meet these requirements, the Voyager and Galileo Power Management And Distribution (PMAD) architectures employed shunt regulation and carried on the Mariner tradition of AC power distribution to many of the user loads. Also, autonomous fault recovery was achieved by automatic responses in hardware and software recovery routines. Finally, power distribution switching was expanded to allow for removal of the most trivial load element as the nuclear source depleted itself. The design cycle has begun for a third generation spacecraft set named Comet Rendezvous Asteroid Flyby (CRAF) and Cassini (a saturn orbiter). In their power systems, AC power distribution, relay/fuse load switching, and fault protection will give way to the advantages of DC power and solid state load switches.
ESA

N92-13205*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
POWER SUPPLY FOR A MANNED INTERNATIONAL ASTEROID MISSION
Stefan Weingartner, Henry K. Nahra, Lisa L. Kohout, and Max Larin (Moscow Inst. of Aviation Technology, USSR) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 359-364 (For primary document see N92-13153 04-20)
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A feasibility study considering the exploitation of a near Earth asteroid was performed. The power requirements and proposed power systems for the crew vehicle, cargo vehicles, mining and processing equipment are described. A photovoltaic power system was selected to meet the 52.1 kWe and the 3.9 kWe power requirements of the crew and cargo vehicles, respectively. A nuclear power plant using a thermodynamic Rankine cycle with a total mass of 62.1 tons was chosen to provide the 7.225 MWe and the 5.5 MWth required for the mining and processing activities at the asteroid.
ESA

N92-13206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SEI POWER SOURCE ALTERNATIVES FOR ROVERS AND OTHER MULTI-kWe DISTRIBUTED SURFACE APPLICATIONS
D. J. Bents, Lisa L. Kohout, B. I. McKissock, C. D. Rodriguez, C. A. Withrow, A. Colozza, J. C. Hanlon, and P. C. Schmitz (Sverdrup Technology, Inc., Brook Park, OH.) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 365-374 Previously announced as N91-28277 (For primary document see N92-13153 04-20)
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Results of the study performed to support the Space Exploration Initiative (SEI) which investigated power system alternatives for the rover vehicles and servicers that would be used for construction and operation of a lunar base is described. Using the mission requirements and power profiles that were subsequently generated for each of these rovers and servicers, candidate power sources incorporating various power generation and energy storage technologies were identified. The technologies were those believed most appropriate to the SEI missions, and included solar, electrochemical, and isotope systems. The candidates were characterized with respect to system mass, deployed area and volume. For each of the missions a preliminary selection was made. Results of this study depict the available power sources in light of the mission requirements as they are currently defined.
ESA

N92-13207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ISSUES AND STATUS OF POWER DISTRIBUTION OPTIONS FOR SPACE EXPLORATION
Robert W. Bercaw, Ronald C. Cull, and Barbara H. Kenny *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 375-380 (For primary document see N92-13153 04-20)
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The Space Exploration Initiative (SEI) will need a wide variety of manned systems with requirements significantly different than those for existing systems. The concept of a space power utility is discussed and the impact of this concept on the engineering of space power systems is examined. Almost all existing space power systems use low voltage direct current. Although they have been very succesful, increasing power system requirements in recent years have exposed their inherent limitations and led to the proposal of a number of alternatives including high voltage DC and AC at various frequencies. Drawing on the experience gained from Space Station Freedom and SEI systems studies, factors that may affect the choice of frequency standards on which to build such a space power utility are discussed.
ESA

N92-13208# British Aerospace Public Ltd. Co., Stevenage (England).
SIMPA: A POWER SYSTEM EQUIPMENT SIZING TOOL FOR GEOSTATIONARY SATELLITES
Stephen Terence King and Barry Lynch (Generics, Software Ltd., Dublin, Ireland) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 383-393 (For primary document see N92-13153 04-20)
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SIMPA is a computer software simulation tool to aid in the sizing of power systems for geostationary satellites. SIMPA runs on any IBM personal computer or compatible. The program structure and error trapping, user screens, algorithms and assumptions used are described. Examples are presented showing the flexibility of SIMPA. These cover battery and battery discharge regulator sizing using buck and boost discharge regulators, the effect of solar array latchup on the sunlight regulated power bus and the effect of increased converter operating frequency on equipment sizing. ESA

N92-13209# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

PSCAP: A MODULAR TOOL FOR POWER SYSTEMS DESIGN AND ANALYSIS

H.-D. Junginger *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 395-401 (For primary document see N92-13153 04-20)

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In order to enable a safer and more economical handling of system design and performance analysis in the area of power system engineering for space systems, the Power System Configuration and Analysis Program (PSCAP) was developed. PSCAP was designed as a modular structured software tool, which will be able to simulate alternative power subsystem configurations, taking into account mission and operational requirements. For the handling of the required input data and the produced output data, the data base management system RSYST was selected. This opens further possibilities such as data base management, generation of plots, and the use of special RSYST command procedures. ESA

N92-13210# Alcatel Espace, Toulouse (France).

GEPOS: GLOBAL EVALUATION AND OPTIMISATION OF FUTURE POWER SYSTEMS CONCEPTS

J. vanDuivenbode, B. Lacore, C. Rym, and R. Salamone (Etudes Techniques et Constructions Aerospatiales, Charleroi, Belgium) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 403-408 (For primary document see N92-13153 04-20)

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Work concerning the development of a software tool that evaluates and optimizes future power system concepts is presented. A general presentation of the software is followed by a discussion of the underlying models and algorithm. It is shown how artificial intelligence techniques can be applied to engineering problems. An example case shows possible applications. ESA

N92-13211# MATRA Espace, Toulouse (France).

PSS SIZING TOOLS: EBLOS, A NEW IMPROVED MODEL

Alain Lehman, Didier Loup, and Didier Alary *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 409-414 (For primary document see N92-13153 04-20)

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Sizing of low Earth orbit power systems is presently achieved by the use of software simulators. The Energy Budget Low order Satellite (EBLOS) program is a software tool used to precisly size new missions using the Power Supply Systems (PSS) based on the paralleling of the solar array and the batteries. EBLOS was developed to simulate these satellites. In spite of some approximations in the program, mainly related to the thermal environment and the battery parameters, the accuracy of the simulation was demonstrated to be sufficient for its present applications. However, future missions require much more various conditions and cannot be simulated precisely. Therefore, the EBLOS program was improved in order to simulate any type of orbit (circular or elliptic, of any inclination and altitude), any type of solar cell and any satellite orbital configuration. In addition, work was performed to reach a more reliable simulation of the battery electrical behavior. The electrical effect of each physical process was identified, and the new model is now able to work with any kind of satellite use. This improved EBLOS software was revalidated, and its accuracy demonstrated over a large range of operating conditions. ESA

N92-13212# Societe des Accumulateurs Fixes et de Traction, Romainville (France). Aerospace Dept.

THE 250 Ah LITHIUM/THIONYL-CHLORIDE CELL EVALUATION TEST RESULTS

J. P. Semerie and J. L. Firmin (Societe des Accumulateurs Fixes et de Traction, Poitiers, France) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 417-421 (For primary document see N92-13153 04-20)

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Test results obtained during evaluation of a primary lithium/thionyl chloride cell developed for use in a booster battery are presented. Cell weight is 2.8 Kg and returned capacity is over 250 Ah in the range 10 to 80 C with currents 0 to 60 A plus pulse capability of 75 A. Average voltage is 3.3 V at 60 A and 45 C. Behavior under some classical abuse testing is described. Discussion of thermal interfaces is done to highlight the conditions to obtain the advantages of the demonstrated energy density of 350 Wh/Kg at C/4 rate. ESA

N92-13213# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

EVALUATION OF SODIUM NICKEL CHLORINE CELLS FOR SPACE APPLICATIONS

G. J. Dudley, B. Hendel, and R. J. Bones (United Kingdom Atomic Energy Authority, Harwell, England) *In its* European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 423-429 (For primary document see N92-13153 04-20)

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Results on tests of two sodium nickel chloride prototype space cells subjected to 2810 charge discharge cycles simulating a low Earth orbit application without failure are reported. The recharge ratio remained high (87 percent), and the increase in internal cell resistance was small. The cell capacity did drop by some 40 percent. Results of the subsequent tear down analyses are also reported. The beta-alumina electrolyte tubes showed no signs of degradation. Examination of the cathode material suggests that the capacity loss is mainly associated with incomplete charging of the thick cathodes at high current rates, but further investigation is necessary. Results are encouraging for future use of this couple for space applications. ESA

N92-13214# Electrotechnical Lab., Ibaraki (Japan).

EXPERIMENTAL AND DESIGN STUDY ON ALKALI METAL THERMOELECTRIC CONVERTER FOR AEROSPACE POWER

T. Masuda, A. Negishi, K. Tanaka, T. Honda, and T. Fujii *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 431-435 (For primary document see N92-13153 04-20)

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The experimental results of the series connected Alkali Metal Thermoelectric Convertor (AMTEC) cells and the theoretical considerations about internal resistances are reported. For the series cells, the open voltage of 2.73 V, the short circuit current of 20 A and the maximum power of 9.24 W at 1077 K were obtained. This power was about 60 percent of the sum power of each single cell. This power decrease was due to the large resistance of the current collecting bus bar. In a design study, numerical data which seemed to be achievable in near future

were assumed. The calculated output power, total cell number, reactor thermal output, radiator output, efficiency and total mass were 300 kW, 3415 cells, 1032 kWt, 732 kWt, 29 percent, and 8059 kg, respectively. ESA

N92-13215# Dowty Batteries, Abingdon (England).
SOME THERMAL CHARACTERISTICS OF A LITHIUM SULPHUR DIOXIDE CELL DEVELOPED FOR SPACE APPLICATIONS
C. E. Newnham and J. Verniolle (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 439-444 (For primary document see N92-13153 04-20)
(Contract ESA-8075/88/NL/RE(SC))
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A knowledge of the thermal characteristics of an electrochemical cell is an important consideration for the safe and efficient thermal design of a battery for space use. A program of work was carried out to obtain information on the thermal capacity and heat generation from a D size lithium sulphur dioxide (Li/SO2) cell for deep space missions. The thermal capacity of the power source was calculated to be 73 J deg (-1). Heat generation determined from calorimetric studies on discharging cells was found to range from 1.41 to 3.95 W per cell, this being dependent on the cell temperature and applied load. The thermoneutral potential of the Li/SO2 cell was calculated from the heat generation data and found to be 3.35 V. This result indicated that the discharge of the Li/SO2 cell would be exothermic at all loads. ESA

N92-13216# Communications Satellite Corp., Clarksburg, MD.
ACTIVE MATERIAL DISTRIBUTION ANALYSIS OF AEROSPACE BATTERY POSITIVE ELECTRODES
T. D. Kirkendall, M. W. Earl, H. Vaidyanathan, and B. L. Shaw *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 445-449 (For primary document see N92-13153 04-20)
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Through long term real life and accelerated eclipse season testing of nickel hydrogen aerospace batteries, the life limiting change occurring in these batteries was identified as the redistribution and chemical information of active material in the positive electrode. This assessment was facilitated by the development of a new quantitative microanalytical technique based on bacskscattered electron imaging of cross sectioned positive electrodes in the scanning electron microscope. The composition and distribution of active material in positve plates from a cell tested for 5,967 simulated low Earth orbit eclipse season cycles is compared to that of a virgin plate. Capacity loss in the cycled plate is attributed to the formation of a dehydrated, less electrochemically active beta nickel hydroxide. This conclusion is supported by results from cyclic voltametry and differential scanning calorimetry. ESA

N92-13217# Centre National d'Etudes Spatiales, Toulouse (France).
NEW HIGH CAPACITY COBALT SUBSTITUTED NICKEL HYDROXIDE ELECTRODE
P. Willmann, C. Delmas, and C. Faure (Laboratoire de Chimie du Solide du CNRS, Talence, France) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 451-455 (For primary document see N92-13153 04-20)
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Alpha turbostatic cobalted nickel hydroxides were obtained by precipitation from nickel and cobalt salts with NaOH solution. Several preparations were developed containing Ni(2+) and Co(3+) ions. These materials were used as positive electrodes in NiCd batteries. The electrochemical cycling between alpha and gamma phases allows up to (1.3 e-) per (Ni + Co) atom to be reversibly exchanged. However, during long term cycling, a slow evolution from the alpha/gamma system to the beta(II)/beta(III) is observed. This evolution seems to be due to a partial reduction of Co(3+) ions to Co(2+) at end of the discharge process. ESA

N92-13218# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
EUROPEAN REGENERATIVE FUEL CELL SYSTEMS FOR SPACE STATIONS AND LARGE PLATFORMS
Uwe Benz, Werner Tillmetz, and Karim Bouridah (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 459-465 (For primary document see N92-13153 04-20)
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The basic concepts of a Regenerative Fuel Cell System (RFCS) as an energy storage device for space stations are presented. The focal points of the work are discussed. The development activities concerning the Fixed Alkaline Electrolyte (FAE) electrolyzer technology showed good progress: stable operation for several hundred hours in continuous and intermittent mode, operation up to 25 bar and demonstration of a high cell performance. An energy storage system optimization with respect to a minimum overall mass was performed and the main design data are given. Various system engineering aspects (e.g., preliminary redundancy concept) are discussed. A brief comparison to competing energy storage systems (NiCd and NiH2 batteries) shows that even if only considered from systems mass point of view, the RFCS has an advantage over batteries. Furthermore, a possible integration of the RFCS with the Environmental Control and Life Support System (ECLSS) and propulsion system could even increase this advantage. ESA

N92-13219*# Los Alamos National Lab., NM. Advanced Engineering Technology Group.
ELECTROCHEMICAL ENERGY STORAGE USING PEM SYSTEMS
N. E. Vanderborgh, J. C. Hedstrom, and J. R. Huff *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 467-471 Previously announced as N91-31711 Sponsored by NASA. Lewis Research Center (For primary document see N92-13153 04-20)
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Results of an engineering assessment for future, long lived space power systems for extraterrestrial applications are given. Solar based, regenerative fuel cell power plants formed from either alkaline or Polymer Exchange Membrane (PEM) components are the focus. Test results on advanced PEM fuel cell stack components are presented. ESA

N92-13220# Commissariat a l'Energie Atomique, Grenoble (France).
DEVELOPMENT OF A SOLID POLYMER ELECTROLYTE REGENERATIVE FUEL CELL
F. Andolfatto, R. Durand (Centre de Recherche en Electrochimie Minerale et en Genie des Procedes, Saint Martin-d'Heres, France), A. Eybert-Berard, P. Stevens, and T. Alleau *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 473-477 (For primary document see N92-13153 04-20)
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Some of the problems inherent in running a mini pilot scale Polymer Exchange Membrane (PEM) based water electrolyzer were analyzed and treated. It was found that some of these are inherent in the use of a solid polymer electrolyte and its ion exchange

properties. The use of iridium dioxide electrocatalyst on a porous titanium electrode is described. The mechanism of the hydrogen evolution reaction on IrO2 is analyzed. ESA

N92-13221# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
WATER MANAGEMENT IN A SOLID POLYMER ELECTROLYTE FUEL CELL
R. Mosdale, P. Stevens, F. Novel-Cattin, B. Loppinet, G. Gebel, P. Aldebert, and M. Pineri *In* ESA, European Space Power Conference. Volume 1: Power Systems, Power Electronics, Batteries and Fuel Cells Aug. 1991 p 479-483 (For primary document see N92-13153 04-20)
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It is usually admitted that a proton needs 4 to 6 molecules of water to cross the membrane in a solid polymer electrolyte fuel cell. A study aimed at a better understanding of the contribution of water to the protonic conduction in a polymer electrolyte is presented. An H2/O2 fuel cell functioning with dry oxygen and fully hydrated hydrogen in which the flow rate of hydrogen is much lower than that required to supply enough water on the basis of 4 or 6 H2O/H4(+), is described. It is shown that very little water enters or leaves the cell under load. A neutron experiment which shows that such a fuel cell can work with a dry membrane and dry gases is described. ESA

N92-13222# European Space Agency, Paris (France).
EUROPEAN SPACE POWER CONFERENCE. VOLUME 2: PHOTOVOLTAIC GENERATORS
James J. Hunt, ed. Aug. 1991 314 p Conference held in Florence, Italy, 2-6 Sep. 1991
(ESA-SP-320-Vol-2; ISBN-92-9092-122-6; ISSN-0379-6566; ETN-91-90066) Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Photovoltaic generators are considered. Specific subjects investigated include: solar cell technology; solar cell assembly technology; solar cell/array tests; measurements and modeling; solar array technology; solar array environmental effects and flight data. For individual titles, see N92-13223 through N92-13272.

N92-13223# Messerschmitt-Boelkow G.m.b.H., Ottobrunn (Germany, F.R.). Space Communications and Propulsion Systems.
ASSESSMENT OF THIRD GENERATION SOLAR CELLS
G. J. LaRoche, W. Schultze, I. Rizos, and K. Bogus (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 487-493 (For primary document see N92-13222 04-20)
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Third generation solar cells for use on solar generators selected for typical future space missions were investigated. Detailed information on the cell status and the development potential was provided. On the basis of these data specially selected missions in low Earth orbit, geostationary orbit, and interplanetary space were defined and the corresponding spacecraft equipped with solar generators utilizing each of the cell candidates for power generation. Characteristic solar generator parameters were determined for each candidate and mission. The evaluation of these data together with the assessment of the actual development status resulted in parameters enabling a quantitative and qualitative assessment of each candidate for application in future missions. Since silicon solar cells presently have the highest development status and still enough potential for further improvements, silicon was found to be the leading solar cell candidate for the near future. But some other candidates have been identified which would be superior to silicon as soon as a comparably high development status are achieved. Higher costs of those candidates can be compensated by savings on subsystem and system level. ESA

N92-13224# Centro Informazioni Studi Esperienze, Milan (Italy).
THIN GaAs/Ge SOLAR CELL DEVELOPMENT
B. Bollani, R. Campesato, R. L. Crabb (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands), C. Flores, F. Paletta, D. Passoni, G. Timo, and A. Tosoni *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 495-500 (For primary document see N92-13222 04-20)
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Thin GaAs/Ge Metalorganic Chemical Vapor Deposition (MOCVD) solar cells were developed in order to overcome the high cost and fragility of conventional GaAs/GaAs cells. Cells with passive rather than active tandem structures were developed in order to maintain the intrinsic advantages of GaAs/GaAs cells, namely high radiation and temperature resistance. Test results are presented for 100 to 200 micron thick solar cells with conversion efficiencies up to 19 percent air mass zero (AM0) 25 C. ESA

N92-13225# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
InP SOLAR CELLS FOR SCIENTIFIC SATELLITE APPLICATIONS
K. Takahashi, M. Kohbata, A. Ohnishi, T. Hayashi, A. Ushirokawa, M. Yamaguchi, S. Ikegami, K. Hashimoto, H. Arai, and T. Orii (Nippon Electric Co. Ltd., Yokohama, Japan) et al *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 501-506 (For primary document see N92-13222 04-20)
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High efficiency homojunction InP solar cells were developed. To evaluate and qualify them for space applications, various environmental tests were conducted on the ground. Additionally, the InP cells were installed as a radiation degradation characteristic instrument onto the EXOS-D scientific satellite and as a power source for the lunar orbiter on board Muses-A. Large decreases in the short circuit current and the open circuit voltage on the cells on board the EXOS-D satellite were found to be due to lower energy proton irradiation. Output power of the solar array for the lunar orbiter was at predicted levels until the separation from the 13th satellite to place the orbiter in orbit around the Moon. ESA

N92-13226# English Electric Valve Co. Ltd., Chelmsford (England).
GaAs SPACE SOLAR CELLS: A EUROPEAN PILOT PRODUCTION FACILITY
T. A. Cross, C. M. Hardingham, and S. P. Wood *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 507-511 (For primary document see N92-13222 04-20)
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Until recently, the volume commercial production of GaAs solar cells has been limited to the U.S. and Japan. The commissioning of a European 1 kW pilot line which is now producing GaAs solar cells with production efficiencies of over 18 percent (air mass zero, 1 sun) is reported. The development of a cost effective gold plated molybdenum interconnector compatible with ultrasonic welding is investigated. On orbit demonstration of this solar cell technology is scheduled for mid 1991 with the launch of a power panel on the forthcoming UoSAT-F microsatellite. ESA

N92-13227# English Electric Valve Co. Ltd., Chelmsford (England).
DIFFUSED JUNCTION, SURFACE TEXTURE ENGINEERED GaAs HETEROFACE SOLAR CELL
C. M. Hardingham and T. A. Cross *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 513-516 (For primary document see N92-13222 04-20)

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Surface texture engineered (i.e., V-grooved front surface and recessed contact metallization) GaAs heteroface space solar cells are considered. Surface texture engineering of Infinite Melt Liquid Phase Epitaxy (IMLPE) cells is discussed. Compatibility with current pilot production manufacturing process, in particular with the front contact metallization system, is demonstrated. Cell I-V results showing no deleterious effects from recessing front contacts are presented. ESA

N92-13228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THIN-FILM PHOTOVOLTAICS: STATUS AND APPLICATIONS TO SPACE POWER

Geoffrey A. Landis (Sverdrup Technology, Inc., Brook Park, OH.) and Aloysius F. Hepp *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 517-522 (For primary document see N92-13222 04-20)

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The potential applications of thin film polycrystalline and amorphous cells for space are discussed. There have been great advances in thin film solar cells for terrestrial applications; transfer of this technology to space applications could result in ultra low weight solar arrays with potentially large gains in specific power. Recent advances in thin film solar cells are reviewed, including polycrystalline copper iridium selenide and related I-III-VI2 compounds, polycrystalline cadmium telluride and related II-VI compounds, and amorphous silicon alloys. The possibility of thin film multi bandgap cascade solar cells is discussed. ESA

N92-13229# Tsukuba Space Center (Japan).

INVESTIGATION OF SILICON SOLAR CELL AND MODULE REVERSE CHARACTERISTICS

M. Uesugi, T. Noguchi, Y. Tonomura, T. Hisamatsu, T. Saga, T. Matsutani, and A. Suzuki (Sharp Corp., Nara, Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 523-528 (For primary document see N92-13222 04-20)

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Investigations into the reverse characteristics of ultrathin silicon solar cells and modules for space application are reported. Based on the acquired data, a computer simulation program for evaluation of reverse characteristics of the shadowed cell and module was proposed. The results of experiments suggested the possibility that breakdown occurred at relative low reverse bias voltage (about 20 V) due to raising of the cell temperature on the partially shadowed module in the space environment. ESA

N92-13230*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THIN FILM, CONCENTRATOR, AND MULTIJUNCTION SPACE SOLAR CELLS: STATUS AND POTENTIAL

Dennis J. Flood *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 531-536 Previously announced as N91-31218 (For primary document see N92-13222 04-20)

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Recent, rapid advances in a variety of solar cell technologies offer the potential for significantly enhancing, or enabling entirely new, mission capabilities. Thin film solar cells are of particular interest. A review is provided of the status of those thin film cell technologies of interest for space applications, and the issues to be resolved before mission planners can consider them. A short summary of recent developments in concentrator and multijunction space solar cell and array technology is given. ESA

N92-13231# Telefunken System Technik G.m.b.H., Wedel (Germany, F.R.).

PILOT-LINE PRODUCTION OF ALUMINIUM INTERCONNECTED SOLAR MODULES

U. Hoffmann and J. C. Larue (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 537-542 (For primary document see N92-13222 04-20)

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An interconnection technology for photovoltaic space solar cells was developed using aluminum alloy interconnectors. The interconnectors are joined to the solar cells by means of an ultrasonic welding process. The Al alloy interconnector technique provides intrinsic protection against atomic oxygen corrosion and a cabling weight reduction potential. The developmental investigations for the selection of the candidate interconnector alloys as well as the solar cells, structure, and weld equipment are described. Verification of the design and final interconnector alloy selection is to be executed on five inlet line modules after a thermal cycling test. The test simulates a five year mission in low Earth orbit. ESA

N92-13232# English Electric Valve Co. Ltd., Chelmsford (England).

INTERCONNECTING AND CONTACTING TO InP BASED SOLAR CELLS

C. M. Hardingham, J. Burrage, S. McLeod, T. A. Cross, N. M. Pearsall, I. Forbes, and J. Winckler (Newcastle-upon-Tyne Univ., England) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 543-546 Sponsored in part by Dept. of Trade and Industry and Science Research Council LINK (For primary document see N92-13222 04-20)

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Indium phosphide (InP) based solar cells show promise for space applications due to their excellent radiation resistance. However, due to the early stage of development, it has not been possible to assess the suitability of these cells for array integration. The ultrasonic bonding of flight standard interconnects, based on either silver or gold, onto the epitaxially grown InP homojunction and the indium tin oxide/InP cell is studied. It is shown that bonds of reasonable pull strength can be effected without degradation of cell properties. ESA

N92-13233# Pilkington Bros. Ltd., Ormskirk (England).

CMG: COVERGLASS FOR GALLIUM ARSENIDE CELLS

P. A. White *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 547-550 Sponsored in part by RAE (For primary document see N92-13222 04-20)

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A specific coverglass (CMG) for GaAs solar cells was developed to optimize the performance of these cells. The development and properties of CMG are presented. By using CMG coverglasses on GaAs cells it is felt that a more advanced and lighter solar cell assembly can be produced. Because the glass is expansion matched it significantly reduces any stresses within the cell assembly caused by thermal cycling. It allows advanced bonding techniques such as electrostatic bonding to be implemented or alternatively the use of Teflon or a rigid adhesive layer. For GaAs cells the elimination of the coverglass adhesive would be very significant since it would be the first step towards the realization of ultrathin GaAs cells relying on the coverglass for strength. ESA

N92-13234# Pilkington Bros. Ltd., Ormskirk (England).

TEFLON BONDING OF SILICON SOLAR CELLS

P. A. White *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 551-554 (For primary document see N92-13222 04-20)

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The silicon adhesive used to bond the coverglass onto the solar cell can be replaced by a thin layer of fluoroethylkene polymer teflon. The advantage of using Teflon as the adhesive is that it is supplied as a thin sheet in thicknesses of 25 or 50 microns and can be cut to size prior to use. Because the Teflon does not extrude from the join in the same manner as conventional adhesives, the clean up after Teflon bonding is virtually nonexistent. It is considered that the use of a coverglass which is thermally matched to silicon will prevent the build up of thermal stresses which could cause delamination. Work done to data on the Teflon bonding process including the results of some critical end of life tests is reviewed. ESA

N92-13235# Telefunken System Technik G.m.b.H., Wedel (Germany, F.R.).

PREQUALIFICATION OF VERY THIN SILICON SOLAR CELLS ON MODULE LEVEL FOR GEO APPLICATIONS

Gerd Neuhaeusser and Juergen W. Koch *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 555-559 Sponsored in part by ESTEC (For primary document see N92-13222 04-20)

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Solar cells with reduced thicknesses lead to improved power to mass ratios on panel level with advantages for the spacecraft and its mission. Several hundreds of 2 by 4 sq cm solar cells of 70 micron thickness were subjected to all solar array producing loads, followed by a thermal cycling test representing Geosynchronous Earth Orbit (GEO) mission conditions. Two types of solar cells rear side contact configurations were investigated. Major steps of scrap were the welding and coverbonding. Additionally it was found that an intensive incoming inspection will reduce subsequent scrap drastically. All tests were passed without defects and degradations. The applicability of very thin solar cells was successfully demonstrated. ESA

N92-13236# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

HOLOGRAPHIC DISPERSIVE CONCENTRATORS FOR PHOTOVOLTAIC POWER GENERATORS

G. Reich, W. Denner, K. Bogus, C. G. Stojanoff, and H. W. Schock (Stuttgart Univ., Germany, F.R.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 561-566 (For primary document see N92-13222 04-20)

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Photovoltaic (PV) generators based on different semiconductor materials with optimized band gaps can achieve higher efficiency values than those obtained with single junction solar cells. With simultaneous concentration of the incident solar radiation a further improvement of the efficiency is realized. Based on PV space solar generator technology and terrestrial holographic concentrator technology a system analysis is performed that investigates the feasibility of a Holographic Dispersive Solar Generator (HDSG) for space application. The holographic solar concentrator allows simultaneous splitting and concentration of the incident sunlight. The upper limits of concentrator efficiency, spectral bandwidth and concentration ratio of holographic dispersive concentrators are evaluated with respect to the space environmental conditions. Two concepts of photovoltaic power generators with holographic dispersive concentrators for space application are described. ESA

N92-13237# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

GaAs SOLAR PANEL TECHNOLOGY ASSESSMENT

R. L. Crabb, C. Flores, F. Paletta, A. Caon, R. Contini, E. Rossi, and C. Signorini (Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan.) *In its* European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 567-573 (For primary document see N92-13222 04-20)

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The current status of a GaAs solar panel flight demonstration experiment that will culminate with the placement of the 28 W solar panel (one of four) on the small cubic United Kingdom microsatellite STRV-1A is presented. This spacecraft will be launched in mid 1993 into the very damaging radiation environment of a geosynchronous transfer orbit. Results of extensive precursory ground testing aimed at GaAs solar cell module design, assessment, and optimization in terms of in-orbit life expectancy are presented. This test program encompassed electron/proton irradiations, thermal cycling, prolonged UV and high temperature exposure, the determination of thermo-optical alpha/epsilon properties, and the measurement of simulated air mass zero electrical performance V-I characteristics. ESA

N92-13238# Pilkington Bros. Ltd., Ormskirk (England).

ELECTROSTATIC BONDING OF SILICON SOLAR CELLS

P. A. White *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 575-580 Sponsored by ESTEC (For primary document see N92-13222 04-20)

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An alternative method of attaching the coverglass to the solar cell, other than the conventional silicone adhesive, is electrostatic bonding where a direct bond is formed between the glass and the cell, i.e., the adhesive is eliminated. An electrostatic bonding process that is virtually equivalent to the conventional adhesive process in most cases and superior in other instances was developed. The process improvements achieved and the end of life testing performed on the electrostatically bonded Solar Cell Assemblies (SCA) are reported. ESA

N92-13239# Royal Aerospace Establishment, Farnborough (England). Space Dept.

THE CALIBRATION OF SOLAR CELLS IN TERRESTRIAL SUNLIGHT

M. A. H. Davies and C. Goodbody *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 583-587 (For primary document see N92-13222 04-20)

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A method of calibrating solar cells in sunlight is described. This method has been used for at least 15 years, and produces a value of the solar cell's short circuit current for any predetermined space of terrestrial condition. The main advantage of this method is that a large number of cells can be calibrated reasonably quickly at a relatively low cost per cell. Choosing from this large number of standards minimizes spectral mismatch errors when measuring an unknown cell on a laboratory solar simulator. The effect of using standards with good and poor spectral match with the test cells is discussed. ESA

N92-13240# Thiemann und Noack, Freiburg (Germany, F.R.).

ARC DISCHARGES AT NEGATIVELY BIASED SOLAR ARRAYS

H. Thiemann and R. W. Schunk (Utah State Univ., Logan.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 589-595 (For primary document see N92-13222 04-20)

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Arcing effects on solar array test modules were experimentally observed around the gap region between adjacent solar cells and at the solar cell edge substrate interface. Arcing effects around the negatively biased interconnects were not observed. Computer experiments on the interaction of the interconnects with low Earth plasma are reviewed. The situation in the gap and edge regions is assessed according to the quasi neutral potential conditions at these locations and their influence on the plasma particle dynamics.

A possible mechanism for arc discharges at the critical locations involves specific potential structures. This mechanism allows charged particle flow between different locations on the surface through the outer space. ESA

N92-13241# Montpellier Univ. (France).
TESTING METHOD OF INSULATING MATERIALS FOR SPATIAL APPLICATIONS
A. Cherifi, M. Abou-Dakka, A. Toureille, J. B. Dubois, and R. Delard (Centre Val d'Aurelle Paul Lamarque, Montpellier, France) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 597-601 (For primary document see N92-13222 04-20)
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By using a new method and varying the forming parameters, the development of space charge in several thick insulating materials submitted (or not) to beta or gamma high energy radiations is studied. This permits their sensitivity to the spatial conditions to be estimated with a view to selecting the best material for the satellite protection and insulation. By using this testing method the reliability of the future insulating materials in space can be increased. ESA

N92-13242# Artegie (France).
WATTS PER KILO (WPK): SOLAR ARRAY DIMENSIONING TOOL VERSION 2 ENHANCEMENTS
P. Bobo *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 603-607 (For primary document see N92-13222 04-20)
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The main features of the solar array dimensioning tool Watts Per Kilo (WPK) are presented. Emphasis is put on version 2 enhanced modes which accept basic data input to derive intermediate results needed to achieve a solar array design or evaluation. WPK is described from a user's point of view. The common functions such as power output computation or sensitivity curves are reviewed with example of standard output. ESA

N92-13243# National Space Development Agency, Ibaraki (Japan).
PRODUCTION AND IMPROVEMENT OF 50 MICRON AND 100 MICRON THIN SILICON SOLAR CELLS FOR SPACE USE
S. Matsuda, T. Noguchi, M. Uesugi, T. Saga, Y. Tonomura, K. Kamimura, H. Yoshioka, T. Matsutani, and A. Suzuki (Sharp Corp., Nara, Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 609-613 (For primary document see N92-13222 04-20)
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Fifty micron and 100 micron silicon solar cells (phase 1 cells) were produced for eight Japanese satellite programs. The production of thin solar cells showed high mechanical yields and tight distributions of power output. The photolithographic mask and lift off technique to form fine gridlines was introduced to realize high short circuit current. The improved 50 micron and 100 micron cells (phase 2 cells) showed 14.3 percent and 14.8 percent efficiencies respectively. More efficient thin silicon solar cells are under study. The target efficiencies of 50 micron and 100 micron Back Surface Field Reflecting (BSFR) cells are 16 percent and 17 percent respectively. Efficiencies up to 16 percent on 100 micron cells were obtained. ESA

N92-13244# Aix-Marseilles Univ. (France). Lab. de Photoelectricite.
DYNAMICAL ANALYSIS BY INFRARED THERMOGRAPHY OF BREAKDOWN PHENOMENA IN BSFR TYPE REVERSE BIASED SOLAR CELLS MOUNTED ON A GSR3 COUPON IN SIMULATED SPATIAL CONDITIONS
J. P. David, J. Duveau, J. Guerin, A. Michel, and Etienne Rapp (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 615-620 (For primary document see N92-13222 04-20)
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A dynamical analysis of breakdown phenomena in Back Surface Field Reflecting (BSFR) cells mounted on a GSR3 (French acronym for rigid solar array 3rd generation) coupon is made in simulated spatial conditions. BSFR cells are reverse biased in hot spot conditions until breakdown is reached. Observations by IR thermography give a mapping of cell temperature and hot spots localized in failing zones. A post mortem analysis of destroyed cells is made, paying close attention to the failed zones. In conclusion, a quality control approach is achieved, leading to safety zones for cell performances. ESA

N92-13245# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et Recherches en Technologie Spatiale.
INVESTIGATIONS OF TRANSIENTS ON THE SOLAR ARRAY BUS CAUSED BY ELECTROSTATIC DISCHARGES
L. Levy, R. Reulet, D. Sarrail, J.-M. Siguier, and A. P. Robben (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 621-625 (For primary document see N92-13222 04-20)
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Electrostatic discharges are studied as a possible source of hardware damage on solar arrays. During the discharges performed at the laboratory, voltage transients of several hundreds volts were measured on the cells with respect to the array local ground. An electric stress results across the insulating substrate, brief, but much higher than the one from the nominal solar array voltage at steady state. These transients could be triggering events which might initiate breakdowns in the insulating substrate and failures of the solar array. ESA

N92-13246# Centre d'Etudes et de Recherches, Toulouse (France). Dept. d'Etudes et Recherches en Technologie Spatiale.
INVESTIGATION OF THE EFFECTS OF PROTON IRRADIATION ON THE INSULATION PROPERTIES OF KAPTON
V. Hude and A. P. Robben (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 627-631 (For primary document see N92-13222 04-20)
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Following power loss anomalies experienced on the solar arrays of satellites, short circuits were recognized to have occurred between the solar array sections and the carbon fiber structure. A possible cause of the short circuits is a failure of the insulating layer which can be degraded by the space environment. A more singular study of Kapton layer was made. The electrical resistivities of Kapton H, HN and Kapton HN(+) polymer primer were measured for proton irradiations, the irradiated polymeric material being progressively transformed into a conducting or semi conducting layer. Different experiment results are shown. ESA

N92-13247# Indian Space Research Organization, Bangalore. Satellite Centre.
A NEAR OPTIMUM DESIGN OF SOLAR ARRAY FOR STRETCHED ROHINI SATELLITE SERIES-C (SROSS-C)
K. Vijayakumar, M. Sudhakar, N. Srinivasamurthy, and B. L. Agrawal *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 635-640 (For primary document see N92-13222 04-20)
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The Stretched Rohini Satellite Series (SROSS-C) is a part of the program of the Indian Space Research Organization. The SROSS-C is aimed at providing space platforms for various

scientific and application purposes and space qualification of indigenous technologies. To meet all the power requirement conditions of the mission with the available generator area, a new approach to the design philosophy was adopted. The new approach deviates from the customary practice of basing the solar array design on worst case temperature. The near optimum design of the solar array for SROSS-C is described. ESA

N92-13248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ENHANCED EOS PHOTOVOLTAIC POWER SYSTEM CAPABILITY WITH InP SOLAR CELLS
Sheila G. Bailey, Irving Weinberg, and Dennis J. Flood *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 641-645 (For primary document see N92-13222 04-20)
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The Earth Observing System (EOS), which is part of the International Mission to Planet Earth, is NASA's main contribution to the Global Change Research Program which opens a new era in international cooperation to study the Earth's environment. Five large platforms are to be launched into polar orbit, two by NASA, two by ESA, and one by the Japanese. In such an orbit the radiation resistance of indium phosphide solar cells combined with the potential of utilizing five micron cell structures yields an increase of 10 percent in the payload capability. If further combined with the advanced photovoltaic solar array the payload savings approaches 12 percent. ESA

N92-13249# Aerospatiale, Cannes (France).
LOCSTAR SOLAR ARRAY
G. A. Martin, Philippe Samson, and K. Dettlaff Behrens (Telefunken System Technik G.m.b.H., Wedel, Germany, F.R.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 647-651 (For primary document see N92-13222 04-20)
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The structural, mechanical and electrical performances of the LOCSTAR solar array, which was designed using the GSR3 (French acronym for rigid solar array 3rd generation) technology, are described. The two wings of this solar generator are equipped with TST (trademark) back side reflector (BSR) solar cells. The particularity of the solar generator is to include three types of flaps which are used for satellite thermal control, thruster protection, and attitude/orbit control. ESA

N92-13250# Aerospatiale, Cannes (France).
SPOT 4 SOLAR ARRAY
P. Benarroche, R. Laget, E. Conde, and H.-D. Wegmann (Telefunken System Technik G.m.b.H., Wedel, Germany, F.R.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 653-657 (For primary document see N92-13222 04-20)
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The solar array that will equip the next SPOT spacecraft, SPOT 4, is described. The Aerospatiale GSR3 (French acronym for rigid solar array 3rd generation) AMEDE (French acronym for improvement of deployment mechanisms) concept was adapted to the Space Shuttle Orbiter (SSO) mission. The 2.8 kW SPOT 4 solar array is a single U shaped wing. The SPOT 4 solar array is the first of a new generation of solar generators characterized by their deployment concept. ESA

N92-13251# Fokker Space and Systems, Amsterdam (Netherlands). Solar Array Group.
THE SAX SOLAR ARRAY DESIGN AND VERIFICATION
J. T. Konink *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 659-664 (For primary document see N92-13222 04-20)
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The design and verification approach for the solar array on low earth orbit (LEO) Satellite for Astronomy in the X-rays (SAX) scientific satellite is addressed. The solar array is a derivative of the Advanced Rigid Array (ARA) specifically adjusted for the LEO mission. A suitable material choice was made, such as a Kapton indium tin oxide (ITO) layer on the panel rearside to protect the carbon fiber skins against the hostile atomic oxygen environment during its 26 month presence in LEO. The array consists of 2 deployable non suntracking wings each with 3 rigid sandwich panels. Large Back Surface Field Reflecting (BSFR) silicon solar cells will be produced and bonded by TST (trademark). The solar cell stringing is optimized to guarantee a minimum power during the mission for a large range of Solar Aspect Angles (SAA's). The verification approach of the design is based on an extensive analysis effort and a qualification by similarity with previous ARA programs. The test effort on the structural and flight wings is limited. A Design Verification Test (DVT) sample is required to qualify the solar cell and substrate combination for 12,000 cycles in LEO orbit conditions. ESA

N92-13252# Fokker Space and Systems, Amsterdam (Netherlands). Solar Array Mechanism Group.
THE COLUMBUS SOLAR ARRAY
R. Zwanenburg and B. Busz *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 665-670 (For primary document see N92-13222 04-20)
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For the Columbus program a rigid panel fold out solar array was selected, based on the so called flat pack array concept. A single wing array is proposed for the Polar Platform (PPF). The Man Tended Free Flyer solar array is comprised of two similar wings. The large degree of commonality between the two design layouts is essential to the minimization of the overall program cost. The PPF power requirement of 7.7 kW for a single wing puts this design in an entirely new category for Europe. A major challenge is the design of the holddown system for the large and relatively heavy wing package. A unique flexible holddown concept is under development to meet this challenge. ESA

N92-13253# Centre National d'Etudes Spatiales, Toulouse (France).
SPOT 1 SOLAR ARRAY: NOW 5 YEARS IN ORBIT
Etienne Rapp and Philippe Samson (Aerospatiale, Cannes, France) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 671-674 (For primary document see N92-13222 04-20)
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The first French Earth observation satellite was retired after 5 years of operation. Its flexible solar array was designed to provide more than 4 kW after 3 years in orbit. Its actual performance was, unexpectedly, much higher. In orbit information is analyzed in order to improve future predictions. ESA

N92-13254*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEMONSTRATION OF THE ADVANCED PHOTOVOLTAIC SOLAR ARRAY
R. M. Kurland (TRW Space Technology Labs., Redondo Beach, CA.) and P. M. Stella *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 675-680 (For primary document see N92-13222 04-20)
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The Advanced Photovoltaic Solar Array (APSA) design is reviewed. The testing results and performance estimates are summarized. The APSA design represents a critical intermediate milestone for the NASA Office of Aeronautics, Exploration, and Technology (OAET) goal of 300 W/kg at Beginning Of Life (BOL), with specific performance characteristics of 130 W/kg (BOL) and

100 W/kg at End Of Life (EOL) for a 10 year geosynchronous (GEO) 10 kW (BOL) space power system. The APSA wing design is scalable over a power range of 1 to 15 kW and is suitable for a full range of missions including Low Earth Orbit (LEO), orbital transfer from LEO to GEO and interplanetary out to 5 AU. ESA

N92-13255*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ENVIRONMENTAL INTERACTIONS OF THE SPACE STATION FREEDOM ELECTRIC POWER SYSTEM

Henry K. Nahra and C. Y. Lu (Rockwell International Corp., Canoga Park, CA.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 683-688 (For primary document see N92-13222 04-20)

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The Space Station Freedom will be operating in the Low Earth Orbit (LEO) environment. LEO environment operation results in different potential interactions with the Space Station systems including the Electric Power Systems (EPS). These potential interactions result in environmental effects which include neutral species effects such as atomic oxygen erosion, effects of micrometeroid and orbital debris impacts, plasma effects, ionizing radiation effects, and induced contamination degradation effects. The EPS design and its interactions with the LEO environment are described. The results of analyses and testing programs planned and performed thus far to resolve the environmental concerns related to the EPS and its function in the LEO environment are discussed. ESA

N92-13256# Newcastle-upon-Tyne Univ. (England). Photovoltaics Applications Centre.

FLIGHT AND IRRADIATION STUDIES OF ITO/InP SOLAR CELLS

N. M. Pearsall, N. Robson, and I. Forbes *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 689-693 Sponsored in part by Ministry of Defence; Dept. of Trade and Industry; and Science Research Council (For primary document see N92-13222 04-20)

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Indium phosphide based cells show promise for space applications due to superior radiation resistance when compared to silicon and gallium arsenide cells. Data on flight and irradiation experiments for the Indium Tin Oxide/Indium Phosphide (ITO/InP) cell design are presented. Data from the longest running InP solar cell flight experiment (LIPS3) are reported, covering over three years in orbit. Measured short circuit currents remain close to launch values. Annealing data for cells irradiated with 1 MeV protons, with devices showing an increase in all cell parameters are also presented. ESA

N92-13257# Indian Space Research Organization, Bangalore. Dept. of Space.

SOLAR ARRAY FOR THE FIRST INDIAN REMOTE SENSING SATELLITE (IRS-1A): DESIGN AND PERFORMANCE

B. L. Agrawal, N. Srinivasamurthy, K. Vijayakumar, M. Sudhakar, S. K. Sharma, and Suresh Puthanveettil *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 695-699 (For primary document see N92-13222 04-20)

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The first Indian Remote Sensing Satellite (IRS-1A) built by the Indian Space Research Organization was launched on 17 Mar. 1988 into a polar Sun synchronous orbit of 904 km and 99 deg inclination. Power is supplied to the three axis stabilized spacecraft by a rigid array of six panels designed to give a power of 700 W at normal incidence at end of life of three years. The design and fabrication of the array and analyses of its performance for two years in orbit are discussed. ESA

N92-13258*# International Telecommunications Satellite Organization, Washington, DC.

ASSESSMENT OF ATOMIC OXYGEN EROSION OF SILVER INTERCONNECTS ON INTELSAT 6, F3

A. Dunnet and T. D. Kirkendall (Communications Satellite Corp., Clarksburg, MD.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 701-706 Sponsored by NASA, Washington (For primary document see N92-13222 04-20)

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Intelsat 6 F-3 was launched from Cape Canaveral on a Titan 3 launch vehicle. Failure of the launch vehicle resulted in the satellite being marooned in Low Earth Orbit (LEO). During its sojourn in LEO, Intelsat 6 is exposed to an unanticipated environment consisting primarily of atomic oxygen, which will subject the unprotected silver interconnects (nominally 12.5 microns thick) on the solar panel to oxidation and erosion. Rescue by Space Shuttle is being examined. Consequently, Intelsat and Comsat have joined in an effort to determine the condition of the silver interconnects at the anticipated time of reboost and to assess the long term risks to the intended geostationary mission. Ground based tests, theoretical analysis, and a flight experiment aboard STS-41 were executed, and new software was written to calculate the expected total atomic oxygen fluence on the interconnects. ESA

N92-13259*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SOLAR RADIATION FOR MARS POWER SYSTEMS

Joseph Appelbaum and Geoffrey A. Landis (Sverdrup Technology, Inc., Brook Park, OH.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 707-712 (For primary document see N92-13222 04-20) (Grant NAGw-2022)

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Detailed information about the solar radiation characteristics on Mars are necessary for effective design of future planned solar energy systems operating on the surface of Mars. A procedure and solar radiation related data from which the diurnally and daily variation of the global, direct (or beam), and diffuse insolation on Mars are calculated, are presented. The radiation data are based on measured optical depth of the Martian atmosphere derived from images taken of the Sun with a special diode on the Viking Lander cameras; and computation based on multiple wavelength and multiple scattering of the solar radiation. ESA

N92-13260# Aerospatiale, Cannes (France).

THE AMADEUS EXPERIMENT: IN-FLIGHT TEST RESULTS EVALUATION

Delambre Bastard and Mercier Conde (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 713-723 (For primary document see N92-13222 04-20)

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The AMADEUS experiment performed on board the Soviet station MIR offered the advantage of deployment undisturbed by the gravity compensation device; thusly, it was a good way to validate the JAMES software. The experiment consisted of deploying a mock up built of four deployment arms and AMEDE (French acronym for improvement of deployment mechanisms) mechanisms in two and three space directions. Evaluation of the test results provides a good correlation between tests and simulations; 5 percent on the mockup arms' trajectories and 3.5 percent on the global deployment time, giving a good confidence in the actual full scale solar array deployment kinematics (SPOT4/HELIOS, Spacebus solar arrays for example). A description of the inflight experiment is given. Main inputs and outputs of the deployment simulation are considered and tests results are evaluated. Its applicability to solar array deployments is looked into. ESA

N92-13261# Aerospatiale, Cannes (France).
EFFECT OF AN IN-FLIGHT POLLUTION BY THRUSTERS ON A SOLAR ARRAY
L. Pelenc, J. C. Deduit, Etienne Rapp, and A. Rutschle (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 719-723 (For primary document see N92-13222 04-20)
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Evaluation of the TDF1 satellite inflight results showed abnormal behavior in one thermal sensor of the solar array after a few days in orbit (high temperature and overshoot after eclipse recovery). The phenomenon was computer simulated with fair accuracy with regard to the number of parameters involved and the accuracy of inflight measurements. This phenomenon is due to the contamination of a part of the solar array surface by an attitude control thruster during the apogee boost. A clear correlation can be established between the thrusting time and abnormal temperature given by the thermistor. Analysis of eventual effects on power at end of life showed very low degradation risk. Nevertheless, any configuration allowing this pollution should be avoided on future satellites. ESA

N92-13262# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
HST SOLAR GENERATOR ELECTRICAL PERFORMANCE DURING THE FIRST YEAR IN ORBIT
Lothar Gerlach *In its* European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 725-731 (For primary document see N92-13222 04-20)
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The Space Telescope Solar Array (STSA), which is supplying the power for the joint NASA/ESA Hubble Space Telescope (HST) is the largest flexible solar array built to date, carrying 48760 BSFR silicon cells. The double roll out solar array was successfully deployed in orbit on 25 April 1990, one day after launch, and has been designed to survive at least 5 years in low Earth orbit (30,000 thermal cycles). STSA will supply at least 4450 W at 34 V after four years in space. During the first year in orbit the telemetry data received at the ground stations was evaluated in detail and compared with the predictions. The results are presented. ESA

N92-13263# Nippon Electric Co. Ltd., Tokyo (Japan).
SFU SOLAR ARRAY DEVELOPMENT TEST
Y. Shibayama, K. Hama, H. Irikado, T. Okudaira, H. Take, A. Ushirokawa, M. Natori, K. Takahashi, N. Wakasugi, and T. Anzai (Institute for Unmanned Space Experiments Free Flyer, Tokyo, Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 735-740 Sponsored by New Energy and Industrial Technology Development Organization (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Space Flyer Unit (SFU) solar array is a 3 kW, flexible fold out, and retractable solar array on board a Japanese free flyer scheduled to be launched at the end of 1993. Extensive development tests were successfully completed on a SFU solar array engineering model to verify the design requirements. Manufacturing and assembly of the solar array protoflight models have been completed, and acceptance testing will start in May 1991. The development test results for the SFU solar array are outlined. ESA

N92-13264# Nippon Electric Co. Aerospace Systems Corp. (Japan).
THE SOLAR ARRAY OF ASTRO-D SPACECRAFT
Y. Okada, J. Takahashi, Y. Shibayama, M. Tajima, J. Onoda, and M. Kohbata (Tokyo Univ., Japan) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 741-746 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The 15th scientific satellite, ASTRO-D, is being developed. The ASTRO-D X-ray observatory spacecraft, will be launched by a Mu booster in February, 1993. The electrical power for the ASTRO-D is supplied by two deployable solar array wings. The structural and technical design of the ASTRO-D solar array and the test results of an engineering model are outlined. ESA

N92-13265# Sverdrup Technology, Inc., Brook Park, OH.
STRUCTURAL SCALING APPROXIMATIONS FOR SOLAR ARRAYS
Geoffrey A. Landis *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 747-751 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

General scaling rules for a photovoltaic array structure are required in order to compare the effectiveness of different cell technologies. Important evaluation criteria for an array are moment of inertia, resonant frequency of vibrational modes, stiffness against acceleration, and resistance losses in the wiring. Approximate scaling relationships for these parameters for a generic solar array structure are presented. ESA

N92-13266# Ceskoslovenska Akademie Ved, Prague. Inst. of Physics.
ORIGIN OF THE SELF-ANNEALING OF THE RADIATION DAMAGE IN Si, InP, AND GaAs CONCENTRATOR SOLAR CELLS
V. Poulek *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 755-758 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Radiation damage in concentrator solar cells is, under concentrated sunlight, simultaneously annealed. Possible origins of the self annealing of the radiation damage in Si, InP, and GaAs concentrator solar cells are investigated. A thermal recombination enhanced annealing theory is proposed to explain this phenomenon. Physical parameters which play a dominant role in the self annealing process are included in the new self annealing parameter. This parameter influences the efficiency of the self annealing process in concentrator solar cells. ESA

N92-13267# Centro Informazioni Studi Esperienze, Milan (Italy).
GaAs SOLAR CELLS FOR LOW TEMPERATURE LOW INTENSITY APPLICATIONS
R. Campesato and C. Flores *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 759-763 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Use of photovoltaic technology in deep space interplanetary missions or on future planetary stations (e.g., Mars) is of great interest since it avoids utilization of radioisotope generators in space. However, little information is available on the behavior of photovoltaic generators in this severe environment. A research activity was carried out to develop GaAs solar cells suitable to operate at low temperatures and low intensities. Metalorganic Chemical Vapor Deposition (MOCVD) GaAs/GaAs, active GaAs/Ge cells, and passive GaAs/Ge cells were investigated. The cells were then measured at air mass 2 and air mass zero conditions in a wide range of temperature and solar intensities. ESA

N92-13268# Messerschmitt-Boelkow G.m.b.H., Ottobrunn (Germany, F.R.). Space Communications and Propulsion Systems.
DARK FORWARD CURRENT MEASUREMENTS OF SOLAR ARRAYS
H. Preitnacher, A. P. Robben, and Lothar Gerlach (European Space Agency. European Space Research and Technology Center,

ESTEC, Noordwijk, Netherlands) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 765-770 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The dark current measurement system introduced is a comprehensive solution to automatic generator measurements. Once set up, the complete cycle for measuring a reference cell, 3 temperature sensors, and 10 different strings or sections of a solar generator will be performed in such a short time interval that the ambient temperature conditions will remain equal throughout the measurement. This is especially useful during temperature cycling tests where the temperatures vary quickly. Fine graded measurement ranges (8 for voltage and 4 for current) in conjunction with the high resolution of the programmed output voltage (25 mV for the 100 V system and 60 mV for the 250 V system) enable the system to cover the whole selection of measurements on different arrays from single cell to solar panels up to 250 V/10A. ESA

N92-13269# Aerospatiale, Cannes (France).
SOLAR ARRAY MANAGEMENT GUIDE
J. C. Vermalle and M. Roussel (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 771-773 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A solar array management guide aimed at controlling project progress so as to prevent untimely events was validated. The management guide proposed is based on the idea that anticipation is the clue to solving problems. Application of this tenet is achieved by steps: ensuring good understanding of requirements; identification of potential risks; heritage analysis and status; definition of verifications taking into account risks and heritage; simulation of activities; implementation of activities; survey of project progress versus simulation; final examination to draw lessons. The innovation in this management guide comes from organization and systematization of step investigation, which are generally followed intuitively. This logic is applicable to all space products, from part of equipment up to system level. ESA

N92-13270# Centre National d'Etudes Spatiales, Toulouse (France).
EXPERIMENTAL INVESTIGATIONS OF SOLAR CELL AT LOW TEMPERATURE
Denis Schwander *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 775-780 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Safe electric coupling between solar array and switching regulators depends upon the knowledge of static and transient parameters of the solar array. These parameters are necessary to size the snubber circuit for worst cases. The differences between interface conditions for series regulators and shunt regulators are presented. Theoretical and experimental investigations in modeling of solar cells are also presented. ESA

N92-13271# Italian Space Agency, Rome.
DEVELOPMENT AND APPLICATION OF A COMPUTER TOOL FOR GaAs SOLAR ARRAY ELECTRICAL DESIGN AND IN ORBIT PERFORMANCE PREDICTION
F. Svelto, A. Caon, R. Contini, G. DAccolti, and C. Signorini (Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan.) *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 781-786 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A computer tool for the electrical design and space performance prediction for GaAs photovoltaic generator subsystems is presented; Electrical Characteristics Simulation (ECS) and Solar Array Electrical Degradation Simulation (SAEDS) softwares were developed. Electrical performance simulations of gallium arsenide liquid phase epitaxy solar cells, obtained by Single Exponential Model (SEM) and Double Exponential Model (DEM) are computed by ECS and then compared. The degradation factors of solar cells due to integration and environmental conditions as well as the thermal behavior of the solar panel are evaluated and implemented by SAEDS; a particular emphasis was devoted to the protection philosophy from the hot spot phenomena. A design demonstration for an Italian satellite to be injected into a LEO orbit is also given. ESA

N92-13272# Telefunken System Technik G.m.b.H., Wedel (Germany, F.R.).
INVESTIGATIONS AND TESTS WITH STATE-OF-THE-ART GaAs-SOLAR CELLS
Gerd Neuhaeusser and Juergen W. Koch *In* ESA, European Space Power Conference. Volume 2: Photovoltaic Generators Aug. 1991 p 787-791 (For primary document see N92-13222 04-20)
Copyright Avail: NTIS HC/MF A14; ESA, EPD, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

GaAs solar cells from different suppliers were investigated in a development program concerning their applicability on module fabrication loads. Process parameters were defined. The results of these investigations were verified on a larger quantity of state of the art GaAs solar cells in liquid phase epitaxy technique, supplied by one manufacturer. Ultrasonic welding of interconnectors, cover glass bonding, and cell laydown were executed successfully with negligible scrap as well as 30,000 low Earth orbit thermal cycles, where no defect occurred. Additionally, the processes were applied successfully on 15 GaAs:Ge solar cells. ESA

N92-13273*# College of William and Mary, Williamsburg, VA. Dept. of Physics.
SOLID ROCKET MOTOR WITNESS TEST Final Report
Christopher S. Welch Washington NASA Dec. 1991 41 p (Contract NAS1-18437)
(NASA-CR-4415; NAS 1.26:4415) Avail: NTIS HC/MF A03 CSCL 21H

The Solid Rocket Motor Witness Test was undertaken to examine the potential for using thermal infrared imagery as a tool for monitoring static tests of solid rocket motors. The project consisted of several parts: data acquisition, data analysis, and interpretation. For data acquisition, thermal infrared data were obtained of the DM-9 test of the Space Shuttle Solid Rocket Motor on December 23, 1987, at Thiokol, Inc. test facility near Brigham City, Utah. The data analysis portion consisted of processing the video tapes of the test to produce values of temperature at representative test points on the rocket motor surface as the motor cooled down following the test. Interpretation included formulation of a numerical model and evaluation of some of the conditions of the motor which could be extracted from the data. These parameters included estimates of the insulation remaining following the tests and the thickness of the charred layer of insulation at the end of the test. Also visible was a temperature signature of the star grain pattern in the forward motor segment. Author

N92-13274*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OVERVIEW OF ROCKET ENGINE CONTROL
Carl F. Lorenzo and Jeffrey L. Musgrave 1991 13 p Proposed for presentation at the Ninth Symposium on Space Nuclear Power Systems, Albuquerque, NM, 12-16 Jan. 1991; sponsored by the Univ. of New Mexico
(NASA-TM-105318; E-6673; NAS 1.15:105318) Avail: NTIS HC/MF A03 CSCL 21H

The issues of Chemical Rocket Engine Control are broadly covered. The basic feedback information and control variables used in expendable and reusable rocket engines, such as Space

Shuttle Main Engine, are discussed. The deficiencies of current approaches are considered and a brief introduction to Intelligent Control Systems for rocket engines (and vehicles) is presented.
Author

N92-13275*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF A SINGLE-PHASE HARMONIC POWER FLOW PROGRAM TO STUDY THE 20 kHz AC POWER SYSTEM FOR LARGE SPACECRAFT
L. Alan Kraft (Valparaiso Univ., IN.) and M. David Kankam Nov. 1991 37 p
(NASA-TM-105326; E-6687; NAS 1.15:105326) Avail: NTIS HC/MF A03 CSCL 10B

The development of software is described to aid in design and analysis of AC power systems for large spacecraft. The algorithm is an important version of harmonic power flow program, HARMFLO, used for the study of AC power quality. The new program is applicable to three-phase systems typified by terrestrial power systems, and single-phase systems characteristic of space power systems. The modified HARMFLO accommodates system operating frequencies ranging from terrestrial 60 Hz to and beyond aerospace 20 kHz, and can handle both source and load-end harmonic distortions. Comparison of simulation and test results of a representative spacecraft power system shows a satisfactory correlation. Recommendations are made for the direction of future improvements to the software, to enhance its usefulness to power system designer and analysts. Author

N92-13276*# GenCorp Aerojet, Sacramento, CA.
ORBITAL TRANSFER VEHICLE ENGINE TECHNOLOGY: BAFFLED INJECTOR DESIGN, FABRICATION, AND VERIFICATION Final Report
J. A. Schneider Washington NASA Nov. 1991 234 p
(Contract NAS3-23772)
(NASA-CR-4387; E-6413; NAS 1.26:4387) Avail: NTIS HC/MF A11 CSCL 21H

New technologies for space-based, reusable, throttleable, cryogenic orbit transfer propulsion are being evaluated. Supporting tasks for the design of a dual expander cycle engine thrust chamber design are documented. The purpose of the studies was to research the materials used in the thrust chamber design, the supporting fabrication methods necessary to complete the design, and the modification of the injector element for optimum injector/chamber compatibility. Author

N92-13277# Utah Univ., Salt Lake City. Dept. of Mechanical Engineering.
A NOVEL TECHNIQUE TO STIMULATE THE FLOW IN A SOLID PROPELLANT ROCKET Final Report, Aug. 1986 - Jun. 1990
W. K. VanMoorhem, Yiping Ma, R. W. Shorthill, K. Chen, and N. Rao Sep. 1991 75 p
(Contract F04611-86-K-0083)
(AD-A240792; AL-TR-90-080) Avail: NTIS HC/MF A04 CSCL 21/8

An experimental study has been carried out to investigate the occurrence of acoustically generated turbulence and the possible role of this turbulence in the velocity coupling phenomenon that is believed to occur in some acoustically unstable solid propellant rocket motors. A new technique has been developed to carry out this investigation. The burning propellant is simulated by subliming dry ice. This simulation allows relatively long run times and ease of instrumentation as compared to using actual propellants. The technique also reduces the possibility of turbulence being generated by the injection process in a cold flow simulation. Subliming dry ice also has a positive pressure exponent, similar to, but weaker than, an actual propellant. In the experiment a small section of dry ice is contained in a closed tube approximately two meters long which is equipped with a mechanically driven piston at one end. This piston is used to produce strong pressure and velocity waves which propagate over dry ice. GRA

N92-13278# California Inst. of Tech., Pasadena. Jet Propulsion Center.
ELECTRON-CYCLOTRON-RESONANCE PLASMA THRUSTER RESEARCH Final Report, 1 Apr. 1987 - 30 Jun. 1991
F. E. Culick and Joel C. Sercel 31 Aug. 1991 18 p
(Grant AF-AFOSR-0205-87; AF Proj. 2308)
(AD-A241513; AFOSR-91-0809TR) Avail: NTIS HC/MF A03 CSCL 21/3

This report summarizes the results of a three year program devoted to theoretical and experimental research on plasma acceleration by electron-cyclotron-resonance (ECR). Theoretical work in the first year of this effort centered on simple analytical treatment of many of the phenomena which have a role in ECR plasma acceleration. These analytical studies pointed out which phenomena are sufficiently important to be incorporated in the more rigorous theoretical studies of years two and three and also provided vital guidance to the process of designing the experimental apparatus. An experimental facility was developed in the first year of this program so that an ECR research device could be tested. The JPL facility has the unique capability of providing up to 20 kW of S-band microwave power and 18,000 liters/second of high quality vacuum system pumping for the study of advanced microwave propulsion concepts. GRA

N92-13279*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
HIGH-FREQUENCY DATA OBSERVATIONS FROM SPACE SHUTTLE MAIN ENGINE LOW PRESSURE FUEL TURBOPUMP DISCHARGE DUCT FLEX JOINT TRIPOD FAILURE INVESTIGATION
T. F. Zoladz and R. A. Farr Dec. 1991 24 p
(NASA-TM-103557; NAS 1.15:103557) Avail: NTIS HC/MF A03 CSCL 21H

Observations made by Marshall Space Flight Center (MSFC) engineers during their participation in the Space Shuttle Main Engine (SSME) low pressure fuel turbopump discharge duct flex joint tripod failure investigation are summarized. New signal processing techniques used by the Component Assessment Branch and the Induced Environments Branch during the failure investigation are described in detail. Moreover, nonlinear correlations between frequently encountered anomalous frequencies found in SSME dynamic data are discussed. A recommendation is made to continue low pressure fuel (LPF) duct testing through laboratory flow simulations and MSFC-managed technology test bed SSME testing. Author

N92-13086# Joint Publications Research Service, Arlington, VA.
DEBATE ON USE OF NUCLEAR POWER SOURCES IN SPACE. SAGDEYEV POINTS TO DANGER OF NUCLEAR INSTALLATIONS ABOARD SPACECRAFT
R. Sagdeyev *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 44-48 Transl. into ENGLISH from NTR Tribuna, Moscow (USSR), no. 3-4, Feb. 1990 p 10
(For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

N92-13087# Joint Publications Research Service, Arlington, VA.
PONOMAREV-STEPNOY REBUTS ARGUMENTS OF NUCLEAR DANGERS IN SPACE
N. Ponomarev-Stepnoy *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 48-50 Transl. into ENGLISH from NTR Tribuna, Moscow (USSR), No. 3-4, Feb. 1990 p 11 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

23 CHEMISTRY AND MATERIALS (GENERAL)

N92-13280# Ames Lab., IA.
DIMETIZATION KINETICS AND PRODUCTS OF ALPHA-SUBSTITUTED O-QUINODIMETHANES DERIVED FROM BENZENE AND FURAN Ph.D. Thesis
Man-kit Leung Sep. 1991 256 p
(Contract W-7405-eng-82)
(DE91-018555; IS-T-1567) Avail: NTIS HC/MF A12

A-substituent effects on the dimerization of furan-based and benzene-based o-quinodimethanes (o-QDM's) are reported. The mechanistic implications of these results are discussed. Three Ethylidene 2 methylene, 2 ethylidene 3 methylene, and 2,3 diethylidene 2,3 dihydrofuran were prepared by fluoride induced 1,4-conjugative elimination of trimethylsilyl acetate from the appropriate precursors. The (exp 1)H NMR spectra of these furan-based o-quinodimethanes were obtained and the dimerization products of each were studied. It was found that a methyl group at the 3-methylene position retards the rate of dimerization which is consistent with the previously proposed dimerization mechanism, the two-step diradical mechanism. The preparation of a-methyl-, a-cyclopropyl-, a-tert-butyl-, and a-mesityl-o-oxylylene and the kinetics and product analyses of their Diels-Alder reactions and dimerization are reported. Trapping the reactive o-QDM's with methyl methacrylate gives more of the ortho than the meta isomers in all cases we studied. The change from a-methyl- to a-cyclopropyl to a-tert-butyl-o-xylylene results in a decrease of the ortho to meta ratio from 8.8 to 4.3 to 2.2, respectively. The trend of the regioselectivity is consistent with the concerted mechanism.
DOE

N92-13281*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NEW ADDITION CURING POLYIMIDES
Aryeh A. Frimer and Paul Cavano (Case Western Reserve Univ., Cleveland, OH.) 1991 7 p Presented at the Fourth International Conference on Polyimides, Ellenville, NY, 30 Oct. - 1 Nov. 1991; sponsored by the Society of Plastic Engineers
(NASA-TM-105335; E-6702; NAS 1.15:105335) Avail: NTIS HC/MF A02 CSCL 07A

In an attempt to improve the thermal-oxidative stability (TOS) of PMR-type polymers, the use of 1,4-phenylenebis (phenylmaleic anhydride) PPMA, was evaluated. Two series of nadic end-capped addition curing polyimides were prepared by imidizing PPMA with either 4,4'-methylene dianiline or p-phenylenediamine. The first resulted in improved solubility and increased resin flow while the latter yielded a compression molded neat resin sample with a T(sub g) of 408 C, close to 70 C higher than PME-15. The performance of these materials in long term weight loss studies was below that of PMR-15, independent of post-cure conditions. These results can be rationalized in terms of the thermal lability of the pendant phenyl groups and the incomplete imidization of the sterically congested PPMA. The preparation of model compounds as well as future research directions are discussed.
Author

N92-13282# Pennsylvania State Univ., University Park. Dept. of Chemistry.
POLYPHOSPHAZENES
Harry R. Allcock 2 Oct. 1991 27 p
(Contract N00014-91-J-1194)
(AD-A241415; TR-6) Avail: NTIS HC/MF A03 CSCL 07/3

The field of inorganic-organic macromolecules provides a common connecting point to the well-established areas of ceramics, metals, semiconductors, and classical organic polymers. In no system is this relationship clearer than in the field of polyphosphazenes, where controlled changes in macromolecular structure allow the formation of materials that are polymer, ceramics, or metal or semiconductors. Polyphosphazenes are long chain macromolecules that contain a backbone of alternating phosphorus and nitrogen atoms, with two organic, inorganic, or organometallic side groups attached to each phosphorus. Because of the unusual methods of synthesis an almost infinite variety of side groups and combinations of different side groups can be linked to the backbone.
GRA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N92-13283# Illinois Univ., Urbana-Champaign. National Center for Composite Materials Research.
TENSILE/COMPRESSIVE FATIGUE AND INTERFACE CHARACTERIZATION OF Al2O3 FIBER/Al-2.5 PERCENT Li ALLOY METAL MATRIX COMPOSITE
Michael M. Buckley and J. Homeny Jun. 1990 106 p
(AD-A234067; UIUC-NCCMR-90-08) Avail: NTIS HC/MF A06 CSCL 11/4

The fatigue response to cyclic roads of a continuous Al2O3 fiber/aluminum-lithium alloy metal matrix composite was successfully characterized at room temperature and 175 C. Low cycle fatigue was dominated by crack propagation perpendicular to the axial fiber direction at both temperatures. Alternately, high cycle fatigue was governed by crack propagation parallel to the axial fiber direction; at room temperature this crack growth was believed to have occurred through the matrix, whereas at 175 C it propagated through weakened composite interfaces. The interfacial reaction product was also thoroughly characterized for both as-received composites and composites subjected to 10 million cycles at 175 C (defined as runout). In the as-received composite, interfaces ranged in thickness from 0.05 to 0.8 microns. Its growth was non-homogeneous and preferential along the grain boundaries of Al2O3. The reaction product was composed of two phases: (1) LiAl508 (a cubic spinel), and (2) alpha-LiAlO2. The cubic spinel was determined to be the major phase. The combination of cyclic loads (as they affect compressive and tensile strength) and elevated temperatures caused an exaggerated growth of the interfacial reaction zone; the layer thickness after runout ranged from 0.05 to 6.0 microns. This growth process corresponded to a weakening of the interface, which decreased fatigue strength at the elevated test temperature of 175 C.
GRA

N92-13284*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DAMAGE AND FRACTURE IN COMPOSITE THIN SHELLS
Levon Minnetyan (Clarkson Univ., Potsdam, NY.), Christos C. Chamis, and Pappu L. N. Murthy 1991 26 p Presented at the 23rd International SAMPE Technical Conference, Lake Kiamesha, NY, 22-24 Oct. 1991
(NASA-TM-105289; E-6624; NAS 1.15:105289) Avail: NTIS HC/MF A03 CSCL 11D

The effect of fiber fracture on the load carrying capability and structural behavior of a composite cylindrical shell under internal pressure is investigated. An integrated computer code is utilized for the simulation of composite structural degradation under loading. Damage initiation, damage growth, fracture progression, and global structural fracture are included in the simulation. Results demonstrate the significance of local damage on the structural durability of pressurized composite cylindrical shells.
Author

N92-13285*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
COMPRESSION FAILURE OF ANGLE-PLY LAMINATES Interim Report No. 87
Larry D. Peel, Michael W. Hyer, and Mark J. Shuart (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Sep. 1991 174 p
(Grant NAG1-343)
(NASA-CR-189485; NAS 1.26:189485; CCMS-91-19; VPI-E-91-19) Avail: NTIS HC/MF A08 CSCL 11D

The present work deals with modes and mechanisms of failure in compression of angle-ply laminates. Experimental results were obtained from 42 angle-ply IM7/8551-7a specimens with a lay-up of ((plus or minus theta)/(plus or minus theta)) sub 6s where theta, the off-axis angle, ranged from 0 degrees to 90 degrees. The results showed four failure modes, these modes being a function of off-axis angle. Failure modes include fiber compression, inplane transverse tension, inplane shear, and inplane transverse compression. Excessive interlaminar shear strain was also considered as an important mode of failure. At low off-axis angles, experimentally observed values were considerably lower than published strengths. It was determined that laminate imperfections in the form of layer waviness could be a major factor in reducing compression strength. Previously developed linear buckling and geometrically nonlinear theories were used, with modifications and enhancements, to examine the influence of layer waviness on compression response. The wavy layer is described by a wave amplitude and a wave length. Linear elastic stress-strain response is assumed. The geometrically nonlinear theory, in conjunction with the maximum stress failure criterion, was used to predict compression failure and failure modes for the angle-ply laminates. A range of wave length and amplitudes were used. It was found that for 0 less than or equal to theta less than or equal to 15 degrees failure was most likely due to fiber compression. For 15 degrees less than theta less than or equal to 35 degrees, failure was most likely due to inplane transverse tension. For 35 degrees less than theta less than or equal to 70 degrees, failure was most likely due to inplane shear. For theta less than 70 degrees, failure was most likely due to inplane transverse compression. The fiber compression and transverse tension failure modes depended more heavily on wave length than on wave amplitude. Thus using a single parameter, such as a ratio of wave amplitude to wave length, to describe waviness in a laminate would be inaccurate. Throughout, results for AS4/3502, studied previously, are included for comparison. At low off-axis angles, the AS4/3502 material system was found to be less sensitive to layer waviness than IM7/8551-7a. Analytical predictions were also obtained for laminates with waviness in only some of the layers. For this type of waviness, laminate compression strength could also be considered a function of which layers in the laminate were wavy, and where those wavy layers were. Overall, the geometrically nonlinear model correlates well with experimental results. Author

N92-13286# Reinhart and Associates, Inc., Austin, TX.
A RADIOGRAPHIC LAYER COUNTER FOR COMPOSITES Final Technical Report, Jun. 1987 - Feb. 1988
Ronald E. Larsen Jun. 1991 51 p
(Contract DAAK60-87-C-0039)
(AD-A240794; NATICK-TR-91/032) Avail: NTIS HC/MF A04 CSCL 11/4

The Army helmet is a composite of layers of resin-bonded Kevlar. Inadvertent omission of layers or undetected shifting of layers during molding processes can reduce the effective number of fibers in some helmet areas and impair their strength properties. A nondestructive method of 100 percent testing of the helmets, more effective than random sampling by ballistic testing, is needed. This six-month study evaluated the feasibility of using relatively low-energy radioisotopes to gauge the uniformity of Kelvar helmets. The potential for constructing a portable detection unit was also assessed. A laboratory radiometric test system was used to evaluate resin-bonded Kevlar samples, as well as actual Army helmets from current suppliers. It was found that the radiometric test system has the capacity to reflect the general condition of fabricated Kevlar helmets. GRA

N92-13287# Jortner Research and Engineering, Inc., Costa Mesa, CA.
MICROSTRUCTURAL STUDY OF CLOTH-REINFORCED CARBON-CARBON LAMINATES Final Report, Feb. 1989 - Dec. 1990
J. Jortner, S. W. Yurgartis, and K. Morey 30 Jun. 1991 86 p
(Contract N00014-82-C-0405)
(AD-A240817; JR/E-91073) Avail: NTIS HC/MF A05 CSCL 11/4

The microstructure of cloth-reinforced carbon-carbon laminates was studied, with emphasis on features observable at relatively low magnifications, such as: the geometric shape of fiber bundles (yarns), yarn crimp, fiber orientations, nesting of cloth layers, and minimechanical microcracking. The development of these features during processing is discussed, with the aid of observations made with a hot-stage-equipped microscope. Computer-aided digital image analysis techniques are applied to the quantification of yarn shapes. Further quantifications of microstructures are recommended as relevant to improved understanding of the links among processing, microstructure, and thermomechanical behavior of carbon-carbon materials. GRA

N92-13288# North Carolina State Univ., Raleigh.
COMPOSITE MATERIALS DESIGN DATABASE AND DATA RETRIEVAL SYSTEM REQUIREMENTS Final Report, Aug. - Dec. 1988
William J. Rasdorf Aug. 1991 43 p
(Contract DAAL03-86-D-0001; DA Proj. 1L1-62618-AH-80)
(AD-A241012; BRL-CR-673) Avail: NTIS HC/MF A03 CSCL 11/4

The emergence and use of composite materials in engineering applications have increased considerably. A need, therefore, exists to make information available about composite materials, their derivation, their properties, and their use, to researchers and material engineers. To do so requires a greater understanding of the problems and solutions that emerge when integrating composite materials data with computer database technology. Gaining such an understanding will facilitate the eventual development and operation of utilitarian composite materials databases (CMDB) designed to support a collection of analysis and design software. The objective of this report is to establish the requirements for creating a composite materials design database and data retrieval system for use in ballistic applications. The target database is fundamentally an engineering properties database that is designed to support the needs of the analysis, design, and data retrieval software. Of particular concern are the representation of material property data in terms of a data model, interfaces to application software, data retrieval applications, and the role of expert systems in composite material design. Each of these needs is discussed in this report. The eventual objective is to develop a prototype database environment to support these needs. To do so requires a combination of the fields of materials engineering and computer science. GRA

N92-13289# Naval Postgraduate School, Monterey, CA.
CORROSION MECHANISMS AND BEHAVIOR OF A P-130x GR/6063 Al COMPOSITE IN AQUEOUS ENVIRONMENTS M.S. Thesis
Leslie R. Elkin Sep. 1990 62 p
(AD-A241455) Avail: NTIS HC/MF A04 CSCL 11/4

The corrosion mechanisms and behavior of a P-130x graphite fiber reinforced 6063 aluminum composite laminate were studied. Electrochemical and total immersion tests were performed on the composite in 3.5 percent sodium chloride and 5.0 percent sodium sulfate solutions. The effects of pH, the presence of sulfite ions, various heat treatments, and electrolyte aeration were investigated. Some tests were also performed on control monolithic 6063 aluminum specimens. Immersion tests showed that when graphite fibers are exposed simultaneously with the matrix, then galvanic coupling is the principal corrosion mechanism in this composite. However, if the composite cross sectional edges are sealed from contact with the environment, then pitting attack of the surface foils becomes the principal mode of attack, especially in harsh environments (chloride and sulfite ions present in addition to low pH). This form of attack can eventually lead to galvanic corrosion. Low pH and the addition of sulfite ion significantly increase the susceptibility to localized corrosion and the rates of both general and galvanic corrosion. Progressive aging of the composite matrix decreases general corrosion rates in de-aerated solutions.

Electrolyte aeration results in a significant reduction in the composite's resistance to all forms of corrosion. GRA

N92-13290# Washington Univ., Seattle. Dept. of Mechanical Engineering.
A BAR IMPACT TESTER FOR DYNAMIC FRACTURE TESTING OF CERAMICS AND CERAMIC COMPOSITES
L. R. Deobald and A. S. Kobayashi Jul. 1991 23 p
(Contract N00014-87-K-0326)
(AD-A241782; UWA/DME/TR-91/6) Avail: NTIS HC/MF A03 CSCL 11/2

A bar impact test was developed to study the dynamic fracture responses of precracked ceramic bars, Al2O3 and 15/29 percent volume SiCw/Al2O3. Laser interferometric displacement gage data was used together with dynamic finite element analysis to determine the instantaneous crack length and the dynamic stress intensity factor, K sub ID(t), in the fracturing ceramic bars impacted with impactor velocities of 5.8, 8.0, and 10 m/s. The crack velocities increased from 1400 to 2600 m/s with increasing impact velocity. K sub ID(t) initiated at the expected dynamic fracture toughness and increased with time and with increasing impact velocity. The dynamic initiation fracture toughness and an increasing K sub ID(t) with time and increasing impact velocity were obtained. GRA

N92-13291# Sandia National Labs., Albuquerque, NM.
THE LARGE DEFORMATION ELASTIC RESPONSE OF WOVEN KEVLAR FABRIC
W. E. Warren 1991 23 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract DE-AC04-76DP-00789)
(DE91-010582; SAND-91-0653C; CONF-911213-1) Avail: NTIS HC/MF A03

The large deformation elastic response of a plane woven Kevlar fabric is investigated analytically and experimentally. The anaiysis assumes the undeformed geometry to be a sequence of interlaced arcs of circles which reverse at each yarn midpoint, and each yarn is modeled as an extensible elastical subject to certain compatibility conditions. Deflection-force relations for the fabric are determined in terms of the initial weave geometry and the elastic properties of the individual yarns. The theoretical results agree well with the results of experiments performed on a fabric woven from 400 denier Kevlar yarns under conditions of uniaxial loading in both warp and fill directions. DOE

N92-13846*# Pennsylvania State Univ., University Park. Dept. of Engineering Science and Mechanics.
SQUEEZE FLOW AND COMPACTION BEHAVIOR OF TOUGHENED POLYIMIDE MATRIX COMPOSITES
Byung Lip Lee, R. Pater, and M. D. Soucek *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 129-133 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11D

N92-13852*# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
MECHANICAL PROPERTIES OF 2D AND 3D BRAIDED TEXTILE COMPOSITES
Timothy L. Norman *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 169-172 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11D

N92-13854*# Longwood Coll., Farmville, VA. Dept. of Natural Sciences.
THE USE OF CARBORANES AS OXIDATION INHIBITORS FOR CARBON-CARBON COMPOSITES
John T. Petty *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 176-180 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-13292# IIT Research Inst., Bartlesville, OK.
CRITICAL PROPERTY AND HIGH-TEMPERATURE HEAT-CAPACITY MEASUREMENTS ON QUINOLINE AND 5,6,7,8-TETRAHYDROQUINOLINE
W. V. Steele, S. E. Knipmeyer, and R. D. Chirico Jun. 1990 23 p
(Contract DE-FC22-83FE-60149)
(DE90-000246; NIPER-469) Avail: NTIS HC/MF A03

Critical property and high-temperature heat capacity measurements on quinoline and 5,6,7,8-tetrahydroquinoline are reported. From the measurements, critical temperatures of 787 + or - 2 K and 746 + or - 2 K, and critical densities of 336 + or - 3 kg center dot mol(-1) and 304 + or - 3 kg center dot (-1) were obtained for quinoline and 5,6,7,8-tetrahydroquinoline, respectively. Critical pressures of 4820 + or - 50 kPa and 3975 + or - 40 kPa, respectively, were derived from the fitting procedures used. The results from the high-temperature heat capacity measurements were combined with earlier reported measurements at lower temperatures to obtain ideal-gas thermodynamic functions for both quinoline and 5,6,7,8-tetrahydroquinoline in the temperature range 298.15 K to 700 K. The derived values are compared with literature values. Densities for quinoline, estimated using the experimental critical properties determined in this research and extended corresponding states, are compared with literature measurement. Agreement is excellent with a maximum difference of 0.14 percent at 298 K. Using critical properties estimated via group-contribution methods the agreement is not so good. The difference between experimental and calculated values averages 4.5 percent. DOE

N92-13293# Union Carbide Corp., Tarrytown, NY.
IMPROVED CATALYSTS FOR LIQUID HYDROCARBON FUELS FROM SYNGAS
1990 196 p
(Contract DE-AC22-84PC-70028)
(DE90-011510; DOE/PC-70028/T12) Avail: NTIS HC/MF A09

Commercial Fischer-Tropsch (F-T) processes are limited by deficiencies intrinsic to the metal catalysts used (Fe and Co). These are (1) the predominance of normal paraffins in the product, (2) a small liquid motor fuel fraction formed in the total product, and (3) the formation of oxygenated compounds which cause separation and corrosion problems. Research was undertaken to identify molecular sieve candidates that showed improved F-T performance in conjunction with conventional F-T catalyst base metals (Fe and Co). That work identified a few outstanding candidates that provided significantly better yields and product quality and, in addition, exhibited improved catalyst stability when compared with currently available commercial catalysts. This program was initiated to capitalize upon the leads generated by the previous work. The objective included a demonstration of the economic value of a combined catalyst process system. DOE

N92-13294*# Aerojet TechSystems Co., Sacramento, CA.
CARBON DEPOSITION MODEL FOR OXYGEN-HYDROCARBON COMBUSTION Bimonthly Progress Report, 1 Sep. - 31 Oct. 1988
John A. Bossard Oct. 1988 96 p
(Contract NAS8-34715)
(NASA-CR-184195; NAS 1.26:184195; Rept-2427-BM-6; RPT/AA0570.3) Avail: NTIS HC/MF A05 CSCL 21B

The objectives are to use existing hardware to verify and extend the database generated on the original test programs. The data

to be obtained are the carbon deposition characteristics when methane is used at injection densities comparable to full scale values. The database will be extended to include liquid natural gas (LNG) testing at low injection densities for gas generator/preburner conditions. The testing will be performed at mixture ratios between 0.25 and 0.60, and at chamber pressures between 750 and 1500 psi. Author

N92-13295*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
COMBUSTION INSTABILITY ANALYSIS Final Report, 1 Jun. 1989 - 30 May 1990
T. J. Chung 30 May 1990 91 p
(Contract NAS8-36955)
(NASA-CR-184224; NAS 1.26:184224) Avail: NTIS HC/MF A05 CSCL 21B

A theory and computer program for combustion instability analysis are presented. The basic theoretical foundation resides in the concept of entropy-controlled energy growth or decay. Third order perturbation expansion is performed on the entropy-controlled acoustic energy equation to obtain the first order integrodifferential equation for the energy growth factor in terms of the linear, second, and third order energy growth parameters. These parameters are calculated from Navier-Stokes solutions with time averages performed on as many Navier-Stokes time steps as required to cover at least one peak wave period. Applications are made for a 1-D Navier-Stokes solution for the Space Shuttle Main Engine (SSME) thrust chamber with cross section area variations taken into account. It is shown that instability occurs when the mean pressure is set at 2000 psi with 30 percent disturbances. Instability also arises when the mean pressure is set at 2935 psi with 20 percent disturbances. The system with mean pressures and disturbances more adverse that these cases were shown to be unstable. Author

N92-13296 Vanderbilt Univ., Nashville, TN.
INTERACTION BETWEEN CHEMICAL REACTION AND TURBULENCE IN NONPREMIXED H2-AIR COMBUSTION Ph.D. Thesis
Rafael Villasenor-Gutierrez 1991 286 p
Avail: Univ. Microfilms Order No. DA9125322

Two prediction models for a turbulent axisymmetric diffusion flame for H2-Air combustion are presented for supersonic jet flows. In the first code, Code I, the parabolic transport equations describing the velocity and scalar fields are solved by a marching downstream integration procedure. For the second code, Code II, the complete time-averaged 2-D Navier-Stokes equations and the species transport equations are solved in a fully-coupled and implicit manner. The modeled moment transport equations are expressed in Favre form and closure to these equations is done with a gradient-type closure approach. Both equilibrium and nonequilibrium chemistry models are incorporated in Code I. In the finite chemistry analysis, the fast shuffle reactions in the H2-Air reaction system are assumed to be in partial equilibrium and three-body recombination reactions are treated kinetically. The combustion processes for Code II are modeled by an 8-species, 18-step finite rate chemistry model. The turbulence is simulated by Eggers algebraic model. The program employs an implicit finite volume, lower-upper symmetric successive overrelaxation scheme (LU - SSOR) for solving the finite difference equations. The model predictions obtained from Codes I and II are compared to probe measurements in a supersonic H2-Air jet flame by Beach. Comparison of the mixture fracture deduced from Beach's data to the model indicate that for Code I the turbulent transport process is correctly predicted, whereas the numerical results for the mixture fraction profiles of Code II compare poorly with the measurements. The turbulence characteristics of the flow have a significant effect on chemical reaction. Dissert. Abstr.

N92-13297# Emory Univ., Atlanta, GA. Dept. of Chemistry.
TEMPERATURE DEPENDENCE OF THE UPS AND HREELS OF HN3 AND DN3 ON SI(110)
Yue Bu, Jason C. Chu, and M. C. Lin 1991 18 p
(AD-A240793; TR-5) Avail: NTIS HC/MF A03 CSCL 07/4

Nitridation of semiconductor surfaces, particularly that of silicon is an important microelectronic fabrication process. It is also relevant to the preparation of Group III - metal nitrides, such as GaN and InN; they are potential high band-gap semiconductors. Different groups have conducted various investigations on the interaction of nitrogen-containing species with silicon single crystal surfaces. Most of these studies have shown that in the temperature range between 600 to 800 K, a planar or deformed planar structure of Si3N was formed on the surface. At higher temperature the Si3N structure converted into Si3N4 on the silicon surface. In our continuing search for more facile and clean N-sources, we have recently studied the adsorption of hydrazoic acid (HN3) on a Si(110) single crystal surface. GRA

N92-13298# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
SYNTHESIS, CHARACTERIZATION, AND ELECTROPOLYMERIZATION OF FERROCENE SUBSTITUTED ANILINES Technical Report No. 40, May 1989 - May 1991
Colin P. Horwitz, Norman Suhu, and Gregory C. Dailey 12 Jun. 1991 7 p
(Contract N00014-88-K-0732)
(AD-A240866) Avail: NTIS HC/MF A02 CSCL 07/4

The synthesis and electrochemical properties of aniline and aniline like molecules substituted with ferrocene are described. All compounds polymerize upon electrochemical oxidation of the aromatic amine portion of the complex in a CH3CN solution containing Bu4NClO4 as supporting electrolyte. The phenol substituted complex shows its best polymerization characteristics when approximately one equivalent of NEt3 is added to the electrolysis solution. The polymers, characterized by cyclic voltammetry, show well defined couples for the ferrocence but there is no electrochemical indication that the polymer backbones are electroactive. Spectroelectrochemical measurements show changes in the visible absorption spectrum characteristic for formation of the ferricinium cation, in all of the polymers upon oxidation. GRA

N92-13299# Electrochemical Society, Inc., Pennington, NJ.
PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON DIAMOND MATERIALS, VOLUME 91-8 Annual Report
A. J. Purdes May 1991 686 p Presented at the International Symposium on Diamond Materials, Washington, DC, 5-10 May 1991
(Contract N00014-91-J-1419)
(AD-A240915) Avail: NTIS HC/MF A99 CSCL 20/12

This symposium will address all aspects of diamond materials science and technology from growth fundamentals to applications. Both invited and contributed papers will be included. Contributed papers are solicited on the following topics: (1) synthesis techniques; (2) vapor phase diagnostics; (3) nucleation and crystal growth; (4) microstructural characterization and local atomic order; (5) mechanical behavior; (6) optical properties; (7) electronic properties; and (8) manufacturing issues. GRA

N92-13300# American Physical Society, New York, NY.
INTERDISCIPLINARY CONFERENCE ON ELECTRIFIED INTERFACES
Sep. 1990 79 p Presented at Asilomar, CA, 16-21 Sep. 1990
(Contract N00014-90-J-1417)
(AD-A241231) Avail: NTIS HC/MF A05 CSCL 09/1

A meeting was held in Asilomar, Monterey, California, September 16-20, 1990. It brought together a group of scientists interested in theoretical and experimental problems related to nontraditional methods in interfacial electrochemistry, from both fundamental and applied points of view. The past decade has seen a renaissance in the field of interfacial electrochemistry. There are at least three reasons for this growth in interest. Firstly, there has been a general recognition of the importance of interfacial science, resulting in part from the development of thin film technologies and the resultant heightened awareness of corrosion

problems. Secondly, there have been theoretical advances which give promise of insights and predictions. Thirdly, there is the development of new techniques capable of probing the interface on a molecular level. In the near future, these may be able to provide experimental tests of the new theoretical insights. GRA

N92-13301# Ecole Normale Superieure, Paris (France).
CROSSED BEAM STUDIES OF SOME CHEMILUMINESCENT REACTIONS PRODUCING IF Final Report, Jun. 1990 - Jun. 1991
D. Khalil, N. Billy, G. Gouedard, and J. Vigue 15 Jul. 1991 35 p
(Grant AF-AFOSR-0229-90)
(AD-A241261; LSH-ENS-91-07; EOARD-TR-91-09) Avail: NTIS HC/MF A03 CSCL 07/4

We have studied the following series of chemiluminescent reactions: F2 + HI, CH3I, CF3I, CH2I2, CHI3, and CI4. All these reactions can produce IF in the B state. With respect to the previous studies which were made under flow conditions, we have used a crossed-beam experiment. In these conditions, the chemiluminescence signal is very small for the reactions of the iodomethanes (if we except the particular case of CI4 which gives a large signal due to iodine impurity), but this signal is considerably larger for HI. In this case, the spectrum of the chemiluminescence was recorded, which shows that the emitter is indeed IF in its B state. This mechanism involves in a first step the formation of HIF radical and a free F atom. The fluorine atom in the HIF radical migrates to form HF and leaves the I and F atoms free to recombine in any electronic state. Fluorine migration seems forbidden by steric arguments in the case of the CH3IF and similar radicals, explaining the very low chemiluminescence branching ratio in these reactions. GRA

N92-13302# IBM Research Lab., San Jose, CA.
INTERPRETING IR DIFFERENCE SPECTRA
Diane B. Parry, Mahesh G. Samant, and Owen R. Melroy 26 Sep. 1991 35 p
(Contract N00014-82-C-0583)
(AD-A241292; TR-30) Avail: NTIS HC/MF A03 CSCL 07/4

From the evaluation of sample difference spectra based on Gaussian model peaks with known peak characteristics, it is shown that interpretation of some parameters from difference spectra, resulting from the ratioing or subtraction of a poor background spectra, may be inaccurate or misleading. Difference spectra of this type are commonly observed using techniques such as subtractively normalized interfacial Fourier transform infrared spectroscopy (SNIFTIRS), electrochemically modulated infrared reflectance spectroscopy (EMIRS), or similar infrared spectroelectrochemical techniques, as well as some microsample analyses, studies of biochemical processes, and infrared astronomical observations, just to name a few. A mathematical evaluation of the problem is offered to demonstrate what information may realistically be gained from the characteristics of difference spectra. It is shown that in the worst case, where frequency, intensity, and peak width are all changing due to some perturbation of the sample (e.g., from temperature, or surface potential changes between background and sample spectra, etc.), even a qualitative interpretation may not be possible. In many practical cases, however, we show that at least a qualitative interpretation of the data can be obtained from difference spectra. Spectroelectrochemical applications for the calculations shown here are presented as examples, although these results impact a wider range of applications. GRA

N92-13303# Pennsylvania State Univ., University Park. Dept. of Chemistry.
CHARACTERIZATION AND CONDUCTIVITIES OF POLYPHOSPHAZENE-IODINE COMPLEXES
Michael M. Lerner, Andrew L. Tipton, Duward F. Shriver, Alexa A. Dembek, and Harry R. Allcock 2 Oct. 1991 24 p
(Contract N00014-91-J-1194)
(AD-A241342; TR-4) Avail: NTIS HC/MF A03 CSCL 07/6

The preparation of ionically conducting solids is of broad fundamental interest. These materials have applications in solid-state electrochemical devices. Polymer-based complexes possess several advantages over semi-crystalline solids, and these advantages include ease of chemical modification and processability. Recent work has shown that high bulk conductivities at ambient temperature can be obtained for etheric polymer complexes that contain polyiodides. Iodine forms charge-transfer complexes with a wide variety of polymers, or it may disproportionate to form polyiodides. Also, conjugated polymers such as polyacetylene become electronically conducting following reaction with many oxidizing agents, including I2. However, a number of monomers and non-conjugated polymers also form stable, highly conductive complexes with iodine. Examples include poly(vinylpyridine) and poly(alkylsulfides). GRA

N92-13304# David Taylor Research Center, Bethesda, MD. Ship Materials Engineering Dept.
DEVELOPMENT OF NEODYMIUM AND Er3Ni REGENERATOR MATERIALS Final Report
Louis F. Aprigliano, Geoffrey Green, James Chafe, Lisa OConner, and Frank Biancanello Aug. 1991 21 p
(AD-A241592; DTRC/SME-91/50) Avail: NTIS HC/MF A03 CSCL 07/2

Neodymium and Er3Ni powders were produced and examined as possible candidates for use as regenerator matrices in the regenerative heat exchanger of the Gifford-McMahon cycle refrigerator. In the case of Er3Ni, crushed powders were brittle and angular in shape, molten salt produced spheres were heavily oxidized, and gas atomized powder had a low yield (3 percent) and a large fraction of hollow particles. Neodymium powder, which was produced by the rotating electrode method, was smooth and spherical in shape and had a high yield (15 percent) of solid particles. GRA

N92-13305# Pennsylvania State Univ., University Park. Dept. of Chemistry.
ULTRAVIOLET RADITION-INDUCED CROSSLINKING OF POLY(BIS(2-(2-METHOXYETHOXY)ETHOXY) PHOSPHAZENE)
Constance J. Nelson, William D. Coggio, and Harry R. Allcock 2 Oct. 1991 15 p
(Contract N00014-91-J-1194)
(AD-A241746; TR-3) Avail: NTIS HC/MF A03 CSCL 07/6

Chemical crosslinking requires the incorporation of a difunctional reagent, thus introducing impurities into the system. Co-60 gamma irradiation is a much cleaner method, but its limited accessibility and related expense make use of this technique less attractive. We report here that ultraviolet radiation can be used to crosslink this polymer. This method offers advantages in that it allows efficient crosslinking via an inexpensive, readily available ultraviolet radiation source, and yields a pure product. The polymer utilized in this study was synthesized via published methods. GRA

N92-13306# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.
POTENTIAL-DEPENDENT SURFACE RAMAN SPECTROSCOPY OF BUCKMINSTERFULLERENE FILMS ON GOLD: VIBRATIONAL CHARACTERISTICS OF ANIONIC VERSUS NEUTRAL C60
Y. Zhang, G. Edens, and M. J. Weaver Oct. 1991 13 p
(Contract N00014-91-J-1409)
(AD-A241800; TR-113) Avail: NTIS HC/MF A03 CSCL 20/5

Real time surface enhanced Raman spectra have been obtained for thin films of buckminsterfullerene (C60) on gold in acetonitrile during cyclic voltammetric potential excursions. At potentials where neutral C60 is stable, all ten normally active Raman bands are observed, along with three weaker features that are infrared active in the bulk phase vibrational spectra. Upon electroreduction to the C60 monoanion, several Raman-active bands downshift significantly in frequency, most prominently for the Ag mode (1460 cm-1), which decreases by almost 20 cm-1. Additionally, several Hg bands become more intense, and in two cases yield doublets upon C60 formation, most probably reflecting a diminution in molecular symmetry. GRA

N92-13307# International Centre for Theoretical Physics, Trieste (Italy).
STRUCTURE OF POLYVALENT METAL HALIDE MELTS
M. P. Tosi Dec. 1990 17 p
(DE91-634795; IC-90/451) Avail: NTIS HC/MF A03

A short review is given of recent progress in determining and understanding the structure of molten halide salts involving polyvalent metal ions. It covers the following three main topics: (1) melting mechanisms and types of liquid structure for pure polyvalent-metal chlorides; (2) geometry and stability of local coordination for polyvalent metal ions in molten mixtures of their halides with alkali halides; and (3) structure breaking and electron localization on addition of metal to the melt. DOE

N92-13660*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
GAS CHROMATOGRAPHIC CONCEPTS FOR THE ANALYSIS OF PLANETARY ATMOSPHERES Abstract Only
J. R. Valentin, D. K. Cullers, K. W. Hall, R. L. Krekorian, and J. B. Phillips (University of Southern Illinois, Carbondale.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 104 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 07D

N92-13669*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE 2.5-5.0 MICRON SPECTRA OF IO: EVIDENCE FOR H2S AND H2O FROZEN IN SO2 Abstract Only
F. Salama, L. J. Allamandola, F. C. Witteborn, D. P. Cruikshank, S. A. Sanford, and J. D. Bregman *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 115 Prepared in cooperation with National Academy of Sciences/National Research Council, Washington, DC (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 07D

N92-13837*# Murray State Univ., KY. Dept. of Physics and Astronomy.
INVESTIGATION OF THE EXCITED STATE IODINE LIFETIME IN THE PHOTODISSOCIATION OF PERFLUOROALKYL IODIDES
Stephen H. Cobb *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 83-84 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 07D

N92-13919 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Chemical Research.
MICROSTRUCTURAL CHARACTERISATION OF MATERIALS BY ANALYTICAL SCANNING ELECTRON MICROSCOPY
H. P. A. M. vanderStaak *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 365-376 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

N92-13920 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Physical Research Dept.
DISCHARGE PARAMETERS IN FLUE GAS
H. F. A. Verhaart *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 377-383 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

N92-13923 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Chemical Research.
ELECTROCHEMICAL SCREENING OF SEVERAL ALLOYS FOR USE IN A FLUE-GAS DESULPHURISATION PRESCRUBBER
L. M. Butter, E. J. A. Vogelaar, and W. M. M. Huijbregts *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 401-408 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-13308# Oak Ridge National Lab., TN.
MOISTURE-INDUCED EMBRITTLEMENT OF Fe3Al
D. J. Alexander, J. H. DeVan, and V. K. Sikka 1990 5 p Presented at the 4th Conference on Fossil Energy Materials, Oak Ridge, TN, 15-17 May 1990
(Contract DE-AC05-84OR-21400)
(DE90-012413; CONF-900546-9) Avail: NTIS HC/MF A01

Recent tests at ORNL indicate that the ductility of iron aluminides is very sensitive to the test environment. It is believed that the loss of ductility observed in moist air environments is associated with a hydrogen embrittlement phenomenon as a result of dissociation of water vapor and the intake of atomic hydrogen into the aluminide matrix. This possibility will be investigated in a series of tests under controlled environmental conditions. Compact specimens will be tested under controlled stress intensity conditions Crack growth rates as a function of the applied stress intensity will be measured with the direct-current potential drop technique. Initial tests will be conducted in moist air and in vacuum at room temperature. In an additional series of tests, the temperature of the moist air will be varied to permit the determination of an activation energy for the embrittlement process. Fractographic examination of the fracture surfaces will also be performed. It is anticipated that this series of test will increase our understanding of the environmentally-induced embrittlement of iron aluminide alloys. DOE

N92-13309# University of Southern California, Los Angeles. Dept. of Materials Science.
MICROSTRUCTURAL STUDIES OF ADVANCED AUSTENITIC STEELS
J. A. Todd and Jyh-Ching Ren 15 Nov. 1989 206 p Prepared for Oak Ridge National Lab., TN
(Contract DE-AC05-84OR-21400)
(DE90-012981; ORNL/Sub-87-SA663/01) Avail: NTIS HC/MF A10

This report presents the first complete microstructural and analytical electron microscopy study of Alloy AX5, one of a series of advanced austenitic steels developed by Maziasz and co-workers at Oak Ridge National Laboratory, for their potential application as reheater and superheater materials in power plants that will reach the end of their design lives in the 1990's. The advanced steels are modified with carbide forming elements such as titanium, niobium and vanadium. When combined with optimized thermo-mechanical treatments, the advanced steels exhibit significantly improved creep rupture properties compared to commercially available 316 stainless steels, 17-14 Cu-Mo and 800 H steels. The importance of microstructure in controlling these improvements has been demonstrated for selected alloys, using stress relaxation testing as an accelerated test method. The microstructural features responsible for the improved creep strengths have been identified by studying the thermal aging kinetics of one of the 16Ni-14Cr advanced steels, Alloy AX5, in both the solution annealed and the solution annealed plus cold worked conditions. Time-temperature-precipitation diagrams have been developed for the temperature range 600 C to 900 C and for times from 1 h to 3000 h. DOE

N92-13310# National Research Council of Canada, Ottawa (Ontario). Structures and Materials Lab.
INTERMETALLICS: CANADIAN PERSPECTIVE Laboratory Technical Report
V. R. Parameswaran, J.-P. Immarigeon, and W. Wallace 16 Aug. 1990 45 p Presented at the TTCP-P-TP1 Workshop on

Intermetallics, Vancouver, British Columbia, 25 Jun. 1990 Revised
(Contract FE144689NAE01)
(NRC-LTR-ST-1771; CTN-91-60249) Copyright Avail: NTIS HC/MF A03

A brief overview of the Canadian research on intermetallics is presented. Although not much work has been done in Canada on high temperature intermetallics such as aluminides for aerospace applications, numerous studies have been carried out on Zr3Al for nuclear applications and some studies on other intermetallics such as Al3Ti and composites containing Ni3(Al, Zr, F) in an Al matrix. Besides these studies protective coatings based on high temperature intermetallics are also being developed by some private companies, for application to gas turbine engine components. Interest is being developed in various quarters such as universities, government laboratories and industries in Canada on high temperature intermetallics, and some preliminary studies have been initiated. Author (CISTI)

N92-13311*# Analytical Services and Materials, Inc., Hampton, VA.
THE APPLICATION OF STATISTICALLY DESIGNED EXPERIMENTS TO RESISTANCE SPOT WELDING Final Report
Robert A. Hafley and Stephen J. Hales Washington NASA Dec. 1991 53 p
(Contract NAS1-18599)
(NASA-CR-4412; NAS 1.26:4412) Avail: NTIS HC/MF A04 CSCL 11F

State-of-the-art Resistance Spot Welding (RSW) equipment has the potential to permit realtime monitoring of operations through advances in computerized process control. In order to realize adaptive feedback capabilities, it is necessary to establish correlations among process variables, welder outputs, and weldment properties. The initial step toward achieving this goal must involve assessment of the effect of specific process inputs and the interactions among these variables on spot weld characteristics. This investigation evaluated these effects through the application of a statistically designed experiment to the RSW process. A half-factorial, Taguchi L sub 16 design was used to understand and refine a RSW schedule developed for welding dissimilar aluminum-lithium alloys of different thickness. The baseline schedule had been established previously by traditional trial and error methods based on engineering judgment and one-factor-at-a-time studies. A hierarchy of inputs with respect to each other was established, and the significance of these inputs with respect to experimental noise was determined. Useful insight was gained into the effect of interactions among process variables, particularly with respect to weldment defects. The effects of equipment related changes associated with disassembly and recalibration were also identified. In spite of an apparent decrease in equipment performance, a significant improvement in the maximum strength for defect-free welds compared to the baseline schedule was achieved. Author

N92-13312# David Taylor Research Center, Bethesda, MD. Ship Materials Engineering Dept.
BIMETALLIC TUBULARS VIA SPRAY FORMING
Paul Kelley and Angela L. Moran Aug. 1991 26 p
(AD-A240790; DTRC/SME-91-43) Avail: NTIS HC/MF A03 CSCL 11/6

High deposition rate spray forming is a new technology which has been developed to reduce the costs and to improve the performance of a wide variety of engineering alloys. The purpose of this investigation was to demonstrate the ability to produce layered bimetallic structures via the spray forming process. Copper tubulars were used as collectors for spray deposited alloy 625. The collectors were varied in thickness and various interfacial alloys were incorporated to promote bonding between the copper and superalloy. Microstructures and bond strength were determined. In the spray deposition process, a stream of molten metal is atomized by inert gas, producing a spray of liquid droplets which are cooled by the gas and accelerated towards a substrate, where they consolidate to form a nearly fully dense deposit. The process improves on ingot metallurgy in that a rapidly solidified, grain-refined microstructure with limited segregation is produced. GRA

N92-13313# Virginia Univ., Charlottesville. Dept. of Materials Science and Engineering.
PLASTIC INSTABILITIES AND THEIR CONSEQUENCES IN STEELS AND OTHER HIGH STRENGTH ALLOYS. THE INVESTIGATION OF THE FRACTURE OF TITANIUM ALLOYS BY IN-SITU AND ANALYTICAL MICROSTRUCTURAL TECHNIQUES Final Report, 1 Dec. 1987 - 31 Aug. 1991
Heinz G. Wilsdorf 1 Sep. 1991 81 p
(Contract N00014-88-K-0111)
(AD-A240976; UVA/525425/MS91/101) Avail: NTIS HC/MF A05 CSCL 11/6

Some frequently used commercial high strength alloys have a tendency to fail catastrophically despite their ductile fracture mode. Apparently, these alloys develop instabilities during deformation which lead to local shear. The local shear areas often trigger catastrophic failure due to near adiabatic heating. An understanding of these phenomena was the object of the research reported here. Ten high strength alloys have been studied as a function of strain rate. Specifically, the investigation of fracture surfaces of high strength 4340 steel samples tested in tension at quasi-static strain rates showed indeed localized melting accompanied by radial cracking. Surprisingly, at high strain rates up to 10 3/s localized melting and radial cracking were absent; an analysis showed that this behavior was due to plastic deformation in the necked down cross-section which was heated above the ductile brittle transition temperature range, then causing the alloy to fail in a fully ductile manner. The temperature rise at the tip of a crack was modeled and calculated using defeat deformation theory. The model predicted the correct temperature range in the process zone as well as a dependence on microstructure. The latter point was confirmed experimentally on Ti-6Al-4V tensile samples with three different microstructures. The interaction of dislocation cell walls with the spatially varying stress field of a moving crack was calculated and compared with high voltage electron microscope in situ observations. GRA

N92-13314# Texas Univ., Austin. Dept. of Chemistry.
ELECTROCHEMICAL AND SCANNING TUNNELING MICROSCOPIC STUDY OF DEALLOYING OF Cu3Au
Thomas P. Moffat, Fu-Ren F. Fan, and Allen J. Bard 20 Sep. 1991 6 p
(Contract N00014-91-J-1752)
(AD-A241140; TR-3) Avail: NTIS HC/MF A02 CSCL 11/6

Dealloying of Copper gold alloys has been examined by in-situ STM and several electrochemical methods. Three different regimes of behavior were noted. At low overpotentials, clustering of gold atoms occurs near sites of copper dissolution. This is essentially a two-dimensional process. The formation and smoothing of these clusters by capillary action, monitored in real time, demonstrated the highly mobile nature of the surface species. At higher potentials, the electrode is largely passivated by the enrichment of gold. However, there exist small localized regions of three-dimensional roughness which may be correlated to extended dealloying catalyzed by bulk solid-state defects. GRA

N92-13315# Army Lab. Command, Watertown, MA. Material Technology Lab.
SURFACE ANALYSIS OF CHROMATE TREATED COPPER Final Report
Edward Chen and Sin-Shong Lin Sep. 1991 18 p
(AD-A241531; MTL-TR-91-32) Avail: NTIS HC/MF A03 CSCL 11/6

The oxide layers of copper specimens formed by the commercial etching agent Isoprep 201 have been examined by the surface analytical techniques of ESCA spectra and Auger depth profiling. The result indicates that the agent has reduced significantly the surface oxidation, as well as the tarnishing effect of copper. The

presence of Cr on the oxidized surface is found to play a major role in the oxidation kinetics at room temperature. GRA

N92-13316# Army Lab. Command, Watertown, MA. Material Technology Lab.
A METHOD FOR THE DETERMINATION OF Cr, Mn, Mo, Ni AND B IN LOW ALLOY STEEL ARMOR USING ATOMIC ABSORPTION SPECTROSCOPY AND INDUCTIVELY COUPLED ARGON PLASMA EMISSION SPECTROSCOPY Final Report
Wai K. Chin Sep. 1991 13 p
(AD-A241532; MTL-TR-91-35) Avail: NTIS HC/MF A03 CSCL 11/6

A more reliable, accurate, and rapid method to determine the concentration of chromium, manganese, molybdenum, nickel, and boron in low alloy steel armors is described. The various procedures of sample dissolution by acids are given. For each element, the high and low intensity spectral lines are determined for the analytical ranges of interest. Analytical results using spiked standards and standard reference materials from the National Institute of Standards and Technology are in agreement with the certified values. The strength and resistance of an armor steel to ballistic impact can be strongly dependent on the microstructure as well as the alloying elements. The purpose of this study is to develop a simple analytical procedure that yields the high accuracy of atomic absorption spectrophotometry and the speed of inductively coupled argon plasma emission spectrometry, using a minimum of analytical steps in sample preparation, dilution, and wet chemical procedures. GRA

N92-13317# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
PRECIPITATION HARDENING OF A BETA TITANIUM ALLOY BY THE ALPHA-TWO PHASE
L. S. Quattrocchi, D. A. Koss, and G. Scarr 25 Sep. 1991 12 p Prepared in cooperation with GE Co., Cincinnati, OH and Pratt and Whitney Aircraft, East Hartford, CT
(Contract N00014-91-J-1414)
(AD-A241566; TR-2) Avail: NTIS HC/MF A03 CSCL 11/6

The age hardening of beta titanium alloys by the formation of ordered alpha two precipitates based on Ti3Al has been investigated by transmission electron microscopy (TEM) and hardness observations. Results of tests based on the alloy Ti 23Nb 11 Al (atomic percent) show a large precipitation hardening response at temperatures considerably higher than is possible in current beta titanium alloys. TEM identifies the hardening to be caused by the formation of ordered, alpha two precipitates with a lath like morphology. GRA

N92-13318# Naval Postgraduate School, Monterey, CA.
THE INFLUENCE OF THERMOMECHANICAL PROCESSING PARAMETERS ON THE ELEVATED TEMPERATURE MECHANICAL BEHAVIOR OF A 6061 ALUMINUM - ALUMINA METAL MATRIX COMPOSITE MATERIALS M.S. Thesis
Marvin D. Magill Dec. 1990 45 p
(AD-A241741) Avail: NTIS HC/MF A03 CSCL 11/6

A cast, aluminum-based discontinuous metal matrix composite was thermomechanically processed. The material studied was 6061 aluminum containing 10 or 15 volume percent alumina (Al2O3) particles, fabricated by casting and subsequently extruded by Duralcan, Inc. of San Diego, CA. Processing included rolling the extruded bars to large strain values at 350 and 500 C with controlled reheating between passes. Mechanical testing was conducted at temperatures and strain rates ranging from 200 to 500 C and 6.7 x 10(exp -1) to 3.3 x 10(exp -1) s(exp -1) respectively. This material displayed a tendency for increased elongation with an increase in the strain rate above 6.7 x 10(exp -4) s(exp -1) elongation data for the 350 C rolled materials, containing both 10 and 15 volume percent alumina, displayed greater values at lower temperatures than the 500 C rolled materials. Values for strength agreed well with previous results. GRA

N92-13319# Los Alamos National Lab., NM.
HIGH-TEMPERATURE PLASTICITY IN COPPER POLYCRYSTALS
Shuh Rong Chen and U. F. Kocks 1991 13 p Presented at the 1991 American Society of Mechanical Engineers (ASME) Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract W-7405-eng-36)
(DE91-014779; LA-UR-91-1852; CONF-911225-2) Avail: NTIS HC/MF A03

A procedure for testing and analysis is described that elicits the material parameters for deformation at elevated temperatures and at strain rates high enough to make diffusion an unimportant mechanism. As a first step, a simple scaling procedure is used on continuous stress strain curves to reduce the data to essentially one curve: the differentiated, normalized hardening diagram. A unique curve of this kind is then assumed at the microscopic level: it reflects the mechanism of hardening and dynamic recovery through dislocation storage and rearrangement. It can be integrated for arbitrary straining paths; initial texture and texture changes can be incorporated at this step; they may affect macroscopic behavior substantially. The dependence of the scaling parameters on temperature and strain rate can be well treated by thermal activation theory. It allows a condensation of temperature and strain rate into a single combined and normalized variable which may then be plotted against a normalized stress. The behavior on this reduced diagram does not necessarily obey a simple formula, but it is unique and allows extrapolation to temperatures and strain rates outside the range of measurements by interpolation on the reduced diagram. New data are presented for the deformation of pure copper polycrystals. DOE

N92-13320# Pennsylvania State Univ., University Park.
TRANSITION METAL MEDIATED TRANSFORMATIONS OF SMALL MOLECULES
Ayusman Sen 1991 8 p
(Contract DE-FG02-84ER-13295)
(DE91-018807; DOE/ER-13295/5) Avail: NTIS HC/MF A02

We have succeeded in extending the palladium 2 catalyzed alternating copolyermization of carbon monoxide with olefins to include (alpha)-olefins. The second aspect of the use of carbon monoxide as a reactive monomer that we have studied is the catalytic synthesis of polyoxamide and polyurea from alpha, omega-diamines and carbon monoxide. An important application of the new catalysts was in the linear step-growth polymerization of p-divinylbenzene. In order to arrive at an understanding of the elementary steps involved in the Mo(6) oxide catalyzed oxidation of alkanes and olefins, we have examined the anaerobic and aerobic decomposition routes for Mo6 oxoalkyl complexes of the type, (Me2-bipy)2MoO2R2. We have investigated the oxidation of ethers by the platinum 2 ion and by metallic platinum in aqueous medium. Finally, we have examined ways to synthesize metal oxide nanoclusters of well-defined sizes in polymeric matrices. DOE

N92-13321# International Centre for Theoretical Physics, Trieste (Italy).
MELTING IN TRIVALENT METAL CHLORIDES
M. L. Saboungi, D. L. Price, C. Scamehorn (Argonne National Lab., IL.), and M. P. Tosi Nov. 1990 15 p
(DE91-634198; IC-90/410) Avail: NTIS HC/MF A03

We report a neutron diffraction study of the liquid structure of YCl3 and combine the structural data with macroscopic melting and transport data to contrast the behavior of this molten salt with those of SrCl2, ZnCl2 and AlCl3 as prototypes of different melting mechanisms for ionic materials. A novel melting mechanism for trivalent metal chlorides, leading to a loose disordered network of edge-sharing octahedral units in the liquid phase, is thereby established. The various melting behaviors are related to bonding character with the help of Pettifor's phenomenological chemical scale. DOE

N92-13322# Allied-Signal Aerospace Co., Kansas City, MO.
AQUEOUS DRYFILM PHOTORESIST FOR THIN FILM NETWORK PATTERN GOLD ELECTROPLATING

Richard A. Hines Sep. 1991 8 p Presented at the 1st International Congress on Environmentally Conscious Manufacturing, Santa Fe, NM, 18 Sep. 1991
(Contract DE-AC04-76DP-00613)
(DE92-000463; KCP-613-4673; CONF-9109259-7) Avail: NTIS HC/MF A02

An aqueous dryfilm photoresist was evaluated and selected to replace a solvent based resist for pattern gold electroplating of thin film networks. The aqueous resist not only eliminated solvents from the process but also improved resolution, line width control, and underplating of the resist. The new resist has been used to make TFN's with narrow lines and spaces that could not be made with the old resist. The adhesion of the new resist has produced excellent results on sapphire substrates allowing a low yield TFN, made with an etchback process on evaporated gold, to be cocverted to pattern electroplated gold. In contrast with prior positive dryfilm results where snap back caused voids around vias, via resistance has been excellent. DOE

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N92-13323# Ames Lab., IA.
THE INTERACTION OF SMALL OXYGENATED FLUOROCARBONS AND HYDROCARBONS WITH THE Ru(001) SURFACE Ph.D. Thesis
M. M. Walczak Jan. 1990 212 p
(Contract W-7405-eng-82)
(DE90-011749; IS-T-1481) Avail: NTIS HC/MF A10

The interaction of oxygenated fluorocarbons with Ru(001) is investigated by thermal desorption spectroscopy in an effort to model how technologically important lubricants interact with metal surfaces. The data are compared with those of analogous oxygenated hydrocarbons. In the limit of low exposure, fluorinated molecules bond between 8 and 18 kJ/mol more weakly to Ru(001) than analogous hydrocarbons in cases where the interaction arises from oxygen lone pair electron donation to the surface. Adsorbed oxygenated fluorocarbons are more stable toward decomposition than the hydrogenated compounds. The stability of the fluorocarbons is attributed to the weak adsorption bond, the strength of the C-F bond or the adsorption geometry. The adsorption bonds of oligomeric ethers do not increase in multiples of the monoether-surface bond. For a fluorinated diether, the adsorption bond is approximately equal to that of the monoether. For the hydrogenated ethers, the adsorption bond increases up to 35 percent on the addition of an ether linkage. This increase is attributed to adsorption primarily through only one oxygen-metal bond or through several weaker-than-expected oxygen-metal bonds. Fundamental research on the interaction of oxygenated fluorocarbons with metal surfaces, such as that described here, can potentially improve the related industrially important lubricants. DOE

N92-13324 University of Southern Mississippi, Hattiesburg.
EFFECTS OF POLYMER PARAMETERS ON DRAG REDUCTION Ph.D. Thesis
Abbas Mohammad Safieddine 1990 191 p
Avail: Univ. Microfilms Order No. DA9120372

The effects of polymer parameters on fluid drag reduction using polyethylene oxide (PEO), polyacrylamide (PAM), guar gum (GG) and hydroxyethyl cellulose (HEC) were investigated. Due to the unavailability of high molecular weight (MW) water-soluble polymers having narrow molecular weight distribution (MWD), an aqueous preparative size exclusion chromatography (SEC) system capable of fractionating over wide MW ranges was constructed. An online low shear viscometer, coupled to the SEC, measured the instantaneous intrinsic viscosity of the eluting polymer solution and, therefore, served as a MW detector since Mark-Houwink K and a values for all four polymers were known. With the aid of the viscometer, the SEC system was calibrated. The preparative nature of the chromatography system allowed the collection of large volumes of nearly monodisperse fractions of high MW polymers. Depending on the polymer investigated, the MW of the fractions varied, but ranged between 2 x 10(exp 5) and 8 x 10(exp 6) daltons. Also, the preparative SEC approach allowed drag reduction (DR) experiments using well-characterized, narrowly dispersed polymer solutions under controlled tube flow conditions. Correlations of drag reduction performance with primary polymer parameters (i.e., number of chain links, and combinations thereof) were used to test the validity of several theoretical DR models. Walsh's energy model, as well as the Deborah argument, did not completely account for drag reduction behavior under all experimental conditions. This work provides strong experimental evidence in support of the theories suggesting that drag reduction is a result of polymer extension in a turbulent flow field. This macromolecular extension leads to a local fluid viscosity increase, effectively altering the turbulent energy balance. This in turn leads to a reduction in the intensity of the smallest eddies, thereby reducing friction and enhancing flow. Dissert. Abstr.

N92-13325# Bhabha Atomic Research Centre, Bombay (India).
RADIATION INITIATED POLYMERIZATION OF TRIOXANE AND STABILIZATION OF POLYOXYMETHYLENE
M. H. Rao, G. Ramanan, J. T. Kunjappu, and K. N. Rao 1990 21 p
(DE91-638033; BARC-1517) Avail: NTIS HC/MF A03

Gamma ray induced polymerization of trioxane from an indigenous source (M/s. Nuchem Plastics, Faridabad) has been investigated by both in-source and post polymerization techniques. Impurity levels in the trioxane samples are determined and compared with those in an imported material. Critical evaluation of the results of its purification by different methods, viz. treatment with molecular sieves, crystallization from solvents and their variations, has been carried out prior to optimizing the conditions of polymerization. A novel but simple purification procedure employing benzene as the solvent which is found to form a ternary azeotrope with trioxane and water has been developed. The effect of these purification methods on the polymerization efficiency and their dependence on the molecular weight of the polymer formed are also discussed. Experimental details of polymerizing trioxane in 10 kg scale are also described. To improve upon the thermal stabilty of the polyoxymethylene thus formed, protection of the free hydroxyl end groups (end-capping) has been achieved by an acetylation procedure using acetic anhydride in presence of catalytic amounts of sodium acetate. DOE

N92-13326# Pennsylvania Univ., Philadelphia. Dept. of Materials Science and Engineering.
NOVEL SYNTHESIS OF SULFONATED SILICONES Technical Report No. 46, May 1989 - May 1991
J. K. Liu and G. E. Wnek 12 Jun. 1991 10 p
(AD-A240819) Avail: NTIS HC/MF A02 CSCL 07/6

Treatment of silyl ketene acetal-derivatized silicones with trimethylsilyl sulfonyl chloride, followed by hydrolysis in mild base, affords sulfonated silicones in high yield. Silicones having about 90 pct. sulfonate pendants are water soluble, and may be used a new dopants for conducting polymers. These polyanions may also have use as polymer electrolytes having exclusively cation conduction. GRA

N92-13327# Cornell Univ., Ithaca, NY. School of Chemical Engineering.
THE THERMAL DEPROTECTION PROCESS IN AN e-BEAM EXPOSED, PHENOLIC-BASED POLYMER
Treva Long, S. K. Obendorf, and Ferdinand Rodriquez 18 Sep. 1991 13 p
(Contract N00014-85-K-0474)
(AD-A240875; TR-21) Avail: NTIS HC/MF A03 CSCL 07/6

An alkali soluble latent image can be generated in pure poly (tert-butoxy carbonoxy styrene) (PBOCST) by e-beam exposure followed by a post-exposure bake (PEB) at relatively high

temperatures (140-150 C). Pattern wet development operates on the same basis as a PBOCST/acid generator two component system. Deprotection (heating), accelerated by the exposure, yields alkali soluble areas while unexposed areas remain insoluble. Sensitivities of 5-10 micro/cu cm and contrasts of 6-10 have been measured. Complete TBOC deprotection results in a film thickness loss of 35-40 percent as CO2 and isobutene are evolved. A laser interferometer/hotplate setup was used to track film thickness with time during the thermal deprotection process. Infrared analysis confirmed the correlation between conversion and thickness. It was found that a slow initial conversion rate was followed by an exponentially steep rise in rate after the 50 percent conversion point. Activation energies were on the order of 30 kcal/mol. It is apparent that thermolysis in both exposed and unexposed resist occurs during the PEB but that the difference in extent of conversion on exposure is sufficient to generate a pattern. GRA

N92-13328# Washington State Univ., Pullman.
ELECTRON INTERACTION AND OPTICAL GAP OF CONJUGATED POLYMERS
X. Sun, Z. Shuai, K. Nasu, D. L. Lin, and Thomas F. George Sep. 1991 30 p
(Contract N00014-90-J-1193)
(AD-A240876; WSU/DC/91/TR-64) Avail: NTIS HC/MF A03 CSCL 07/6

The controversy over whether the optical gap of a polymer is increased or decreased by the electron-electron interaction can be clarified by studying the effect of the screened Coulomb interaction on the correlation function of the excited states. Since the competition between the diagonal and off-diagonal parts of the electron interaction depends on the screening, the screening becomes the decisive factor in determining the dependence of the optical gap of the electron interaction. Our theory shows that the electron interaction with weak or usual screening increases the optical gap, but if the screening is very strong, the optical gap can be reduced by the electron interaction. GRA

N92-13329# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ELECTROCHEMICAL INVESTIGATIONS OF ELECTRONICALLY CONDUCTIVE POLYMERS. 7: CHARGE-TRANSPORT IN LIGHTLY-DOPED POLYPYRROLE
Zhihau Cai and Charles R. Martin 13 Sep. 1991 39 p
(Contract N00014-82-K-0612)
(AD-A240927; TR-64) Avail: NTIS HC/MF A03 CSCL 07/6

We have shown that the mechanism and rate of charge transport in polypyrrole films (on electrode surface) depend on whether the polymer is in its electronically conductive or electronically insulating state. This paper focuses on the mechanism and rate of charge transport in the electronically insulating state; i.e., we describe results of electrochemical investigations of polypyrrole films which were equilibrated at initial potentials negative of -0.30 V vs. a saturated calomel electrode (SCE). With regard to the mechanism of charge transport, we show that this lightly doped material behaves like a redox polymer. In particular, we show that like other redox polymers, redox reactions for lightly doped polypyrrole begin at the polymer/electrode interface and propagate to the polymer/solution interface. With regard to rate of charge transport, we show that apparent diffusion coefficients for polypyrrole synthesized from acetonitrile solutions containing 2 percent added water are significantly lower than charge transport rates in films synthesized in rigorously-dried acetonitrile. Finally, we report exchange current densities associated with the oxidation of lightly doped polypyrrole. These exchange current densities are on the order of 4 mA cm(exp -2), indicating relatively facile electron transfer kinetics. GRA

N92-13330# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
FRACTURE STUDIES OF DIAMOND FILMS ON SILICON
J. J. Mecholsky, Jr., Y. L. Tsai, and W. R. Drawl 28 Aug. 1991 18 p Prepared in cooperation with Pennsylvania State Univ., University Park
(Contract N00014-90-J-1726)
(AD-A240978; TR-2) Avail: NTIS HC/MF A03 CSCL 07/4

Diamond coatings were prepared on silicon substrates for fracture studies. Two thicknesses of coatings were evaluated: 6 m and 12 m. The diamond films increased the strength of the silicon for the same size fracture initiating crack and thus caused an apparent toughness increase from 1.1 MPam 1/2 for the uncoated silicon to about 1.6 MPam 1/2 for the 12 m coated silicon. Fractography showed that the indentation impression on the coated surface was altered by the coating, but this did not alter the formation of the radial crack beneath the surface so that indentation fracture mechanics can be used for thin coatings with thicknesses below 12 m. Fractography also showed that the coatings separated from the substrate under and near the indentation site, but was still intact away from the indentation. Most of the fracture in the diamond coating was transgranular indicating good intergranular adhesion. GRA

N92-13331# California Univ., Santa Barbara. Inst. for Polymers and Organic Solids.
NONLINEAR OPTICAL PROPERTIES OF SEMICONDUCTING POLYMERS Final Technical Report
Alan J. Heeger 26 Oct. 1990 99 p
(Contract N00014-86-K-0514)
(AD-A241001) Avail: NTIS HC/MF A05 CSCL 20/6

This program focused on the nonlinear optical properties of semiconducting conjugated polymers. Specific emphasis was on fast time (picosecond regime) measurements of the photoconductivity of semiconducting polymers and on nonlinear optics (NLO) measurements related to the mechanism and origin of the nonlinearity and on attempts to optimize the magnitude of the nonlinear response. In the transient photoconductivity area, these publications focused on the carrier generation, mobility and carrier recombination processes. The results are of particular importance; by implementing the Auston switch technique (to enable fast transient photoconductivity measurements with temporal resolution greater than 100 ps), we were able to explore the photogeneration process early times. The results have caused a reevaluation of the previously accepted Onsager geminate recombination process. We succeeded in demonstrating that for conjugated polymers the nonlinear response is highly anisotropic with substantial nonlinearity only when the pump is polarized along the direction parallel to the polymer backbone. In attempting to sort out the NLO mechanism we carried out comparative studies on cis and trans-polyacetylene. The larger NLO response from the trans-isomer (larger by at least a factor of 20) shows the importance of the degerate ground state. GRA

N92-13332# Naval Ocean Systems Center, San Diego, CA.
SKIN FRICTION MEASUREMENTS IN FLOWS OVER TETHERED POLYMER COATINGS Final Report
E. W. Hendricks and D. M. Ladd Jul. 1991 12 p
(AD-A241285; NOSC-TR-1438) Avail: NTIS HC/MF A03 CSCL 13/10

The effect of a tethered polymer coating on the turbulence production in a turbulent boundary layer was examined. An experimental investigation was carried out in the Naval Ocean Systems Center (NOSC) water tunnel. The aims of the study were to determine the existence of an interaction between the tethered polymer coating and turbulence production at the wall and in the outer layer. Skin friction was measured in a flat plate turbulent boundary layer with and without tethered polymer coating. There were no measurable effects on the turbulent boundary layer skin friction. We should point out the purpose of the tethered polymer coatings is the prevention of biofouling on ships. With this fact in mind it is encouraging that the coating has no deleterious effect on the boundary layer. GRA

N92-13333# Pennsylvania State Univ., University Park. Dept. of Chemistry.
STRAINED INORGANIC HETEROCYCLIC COMPOUNDS AND THEIR CONVERSION TO MACROCYCLES AND HIGH POLYMERS
Harry R. Allcock 2 Oct. 1991 31 p
(Contract N00014-91-J-1194)
(AD-A241414; TR-5) Avail: NTIS HC/MF A03 CSCL 07/3

The ring expansion or contraction reactions of inorganic cyclic molecules often depend on structural features such as ring strain or side group intramolecular interactions. The ability of an inorganic cyclic system to undergo ring-opening polymerization to open-chain macromolecules usually depends on the same factors. In this paper the influence of transannular structures or heteroelements in the ring on ring-ring or ring-polymer interconversions will be discussed. Particular emphasis is placed on the way in which certain side groups switch the reaction pathway from ring expansion to polymerization. Polymers formed from these ring systems are of interest as electroactive or elastomeric materials, and structure-property relationships are discussed. GRA

N92-13334# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering.
MICROSCOPIC THEORETICAL MODELING OF THE CHEMICAL AND TRIBOLOGICAL PROPERTIES OF CERAMIC SURFACES AND INTERFACES Final Technical Report, 1 Nov. 1987 - 31 Oct. 1990
William A. Goddard, III Sep. 1991 58 p
(Grant AF-AFOSR-0051-88; AF Proj. 2303)
(AD-A241565; AFOSR-91-0816TR) Avail: NTIS HC/MF A04 CSCL 11/2

The major goal to this research was to develop a strategy for establishing a microscopic atomic level understanding of the fundamental surface processes ultimately responsible for friction, adhesion at surfaces, and abrasion. The approach was (1) to use quantum chemical studies to establish the dominant surface species for clusters of atoms modeling various ceramics and to elucidate the thermochemistry and detailed mechanistic steps involved in surface reactions of such systems; (2) to develop theoretical force fields based on the energy surfaces from clusters in 1 that allow predictions of the energies and geometries for infinite surfaces and interfaces; (3) to use the force fields from 2 to predict the barriers and kinetics for various diffusion and reaction processes relevant for catalysis, corrosion, and materials synthesis processes; (4) to develop procedures for molecular dynamics and Monte Carlo simulations of various chemical processes in these systems, and (5) to interface the results of these simulations onto appropriate graphics systems, allowing the designer to interactively follow a three dimensional image of the evolving system. GRA

N92-13335# Argonne National Lab., IL.
DYNAMICS OF VITREOUS AND MOLTEN ZINC CHLORIDE
D. L. Price, M. L. Saboungi, S. Susman, K. J. Volin, and A. C. Wright (Reading Univ., England) Sep. 1991 13 p Presented at the 5th International Conference on the Structure of Non-Crystalline Materials, Sendai (Japan), 2-6 Sep. 1991
(Contract W-31-109-eng-38)
(DE92-000362; ANL/CP-73443; CONF-9109103-3) Avail: NTIS HC/MF A03

The dynamics of vitreous and molten zinc chloride have been studied with inelastic neutron scattering at the Intense Pulsed Neutron Source. The results are analyzed in terms of the scattering function S(Q,E) and the effective vibrational density of states G(E). The vibrational spectra of both glass and liquid are dominated by broad features centered at 15 and 35 MeV which are identified with F(sub 2) modes of ZnCl4(-2) tetrahedra. The other two normal modes are not observed because of inadequate resolution and broadening and overlap resulting from coupling between tetrahedra. The behavior of ZnCl2 is contrasted with other tetrahedrally coordinated glasses that have been studied with the same technique. DOE

N92-13836*# Hampton Univ., VA. Dept. of Chemistry.
COMPUTATIONAL MODELLING OF POLYMERS
Edward A. Celarier *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 81-82 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11C

N92-13862*# Hampton Univ., VA. Dept. of Chemistry.
POTENTIAL APPROACHES TO THE SPECTROSCOPIC CHARACTERIZATION OF HIGH PERFORMANCE POLYMERS EXPOSED TO ENERGETIC PROTONS AND HEAVY IONS
Naushadalli K. Suleman *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 213-214 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11C

N92-13864*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PREPARATION OF ATOMIC OXYGEN RESISTANT POLYMERIC MATERIALS
Victor J. Tortorelli (Ursinus Coll., Collegeville, PA.), P. M. Hergenrother, and J. W. Connell *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 221-226 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11C

N92-13918 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Physical Research Dept.
VENTED WATERTREES: OXIDATION AND HYDROPHILIC BEHAVIOUR
R. Ross, W. S. M. Geurts, J. J. Smit, J. H. vanderMaas, and E. T. G. Lutz (Utrecht State Univ., Netherlands) *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 357-364 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-13336*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A REVIEW OF CANDIDATE MULTILAYER INSULATION SYSTEMS FOR POTENTIAL USE ON WET-LAUNCHED LH2 TANKAGE FOR THE SPACE EXPLORATION INITIATIVE LUNAR MISSIONS
Richard H. Knoll, Robert J. Stochl, and Rafael Sanabria 1991 21 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASEE Previously announced in IAA as A91-45793
(NASA-TM-104493; E-6351; NAS 1.15:104493; AIAA-91-2176)
Avail: NTIS HC/MF A03 CSCL 20I

The storage of cryogenic propellants such as liquid hydrogen (LH2) and liquid oxygen (LO2) for the future Space Exploration Initiative (SEI) will require lightweight, high performance thermal protection systems (TPS's). For the near-term lunar missions, the major weight element for most of the TPS's will be multilayer insulation (MLI) and/or the special structures/systems required to accommodate the MLI. Methods of applying MLI to LH2 tankage to avoid condensation or freezing of condensible gases such as nitrogen or oxygen while in the atmosphere are discussed. Because relatively thick layers of MLI will be required for storage times of a month or more, the transient performance from ground-hold to space-hold of the systems will become important in optimizing

the TPS's for many of the missions. The ground-hold performance of several candidate systems are given as well as a qualitative assessment of the transient performance effects. Author

N92-13337 Department of the Navy, Washington, DC.
CASTABLE, INSENSITIVE ENERGETIC COMPOSITIONS Patent
May L. Chan, inventor (to Navy) and Alan D. Turner, inventor (to Navy) 23 Apr. 1991 6 p Filed 12 Jan. 1990
(AD-D015006; US-Patent-5,009,728; US-Patent-Appl-SN-464076; US-Patent-Class-149-19.1) Avail: US Patent and Trademark Office CSCL 19/1

Energetic materials exhibiting low sensitivity make up a solid solution of nitroaliphatic oxidizer, preferably trinitroethyl derivatives, in a plasticized thermoplastic elastomer such as a block copolymer of polystyrene and polyacrylate plasticized with dioctyl adipate. The energetic material is prepared by forming molten plasticized elastomer and then incrementally dissolving the oxidizer in the molten binder. GRA

N92-13338# Coordinating Research Council, Inc., Atlanta, GA.
CRC OCTANE NUMBER REQUIREMENT SURVEY 1990
Jul. 1991 143 p
(AD-A241366; CRC-575) Avail: NTIS HC/MF A07 CSCL 21/4

An annual statistical survey of octane number requirements of current model vehicles is conducted by the Coordinating Research Council, Inc. Test data have been obtained from seventeen companies on 356 1990 vehicles including passenger cars and light-duty trucks and vans, of which 169 were equipped with knock sensors. Octane number requirements were determined by testing at maximum-throttle conditions, as well as at part-throttle, with three unleaded fuel series of varying sensitivities. Requirements are expressed as the (R+M)/2 octane number, Research octane number, and Motor octane number of the reference fuel producing knock which was recurrent and repeatable at the lowest audible level. Estimated octane number requirements for the total vehicles are weighted in proportion to the 1990 vehicle model production and/or sales figures. The octane number requirements of 1990 models with average sensitivity unleaded fuels were 85.4 (R+M)/2 octane numbers at the 50 percent satisfaction level, and 89.2 (R+M)/2 octane numbers at the 90 percent satisfaction level. GRA

N92-13339# Tennessee Valley Authority, Muscle Shoals, AL.
TECHNICAL AND ECONOMIC ANALYSES TO ASSESS THE FEASIBILITY OF USING PROPELLANT NO. 2 FUEL OIL SLURRIES AS SUPPLEMENTAL FUELS Final Report, Nov. 1990 - Sep. 1991
V. M. Norwood, D. J. Craft, and K. E. McGill Sep. 1991 155 p
(AD-A241558; CETHA-TS-CR-91046) Avail: NTIS HC/MF A08 CSCL 21/4

There is currently a large inventory of obsolete conventional munitions and waste propellants. Current alternatives to storage are open burning/open detonation (OB/OD) and incineration to reduce the inventory of these materials. Since environmental impact of OB/OD is under intense scrutiny, the U.S. Army Toxic and Hazardous Materials Agency is conducting a program to determine the feasibility of using propellants as supplemental fuels for the Army's industrial combustors. The first propellant studied was a nitrocellulose containing 13.15 percent nitrogen by weight. Laboratory tests were conducted to evaluate the physical and chemical characteristics, as well as the chemical compatibility, of nitrocellulose-solvent-No. 2 fuel oil solutions. Unfortunately, the tests using nitrocellulose indicated that solvation and mixing with No. 2 fuel oil is questionable from a cost standpoint due to the low solubility of this material; an economic analysis did indicate potential cost effectiveness using propellant-No. 2 fuel oil slurries as supplemental fuels. A second project assessed the technical, economic, and safety aspects of using propellant-No. 2 fuel oil slurries as supplemental fuels. Materials studies were nitrocellulose, nitroguanidine, and AA2 double-base propellant. Similar laboratory tests were again conducted. This report discusses results from these tests as well as from an economic analysis of the process. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

N92-13340*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ANALYSIS OF GRAVITY-INDUCED PARTICLE MOTION AND FLUID PERFUSION FLOW IN THE NASA-DESIGNED ROTATING ZERO-HEAD-SPACE TISSUE CULTURE VESSEL
David A. Wolf and Ray P. Schwarz (Krug International, Houston, TX.) Washington Oct. 1991 16 p
(NASA-TP-3143; S-644; NAS 1.60:3143) Avail: NTIS HC/MF A03 CSCL 22A

The gravity induced motions, through the culture media, is calculated of living tissue segments cultured in the NASA rotating zero head space culture vessels. This is then compared with the media perfusion speed which is independent of gravity. The results may be interpreted as a change in the physical environment which will occur by operating the NASA tissue culture systems in actual microgravity (versus unit gravity). The equations governing particle motions which induce flows at the surface of tissues contain g terms. This allows calculation of the fluid flow speed, with respect to a cultured particle, as a function of the external gravitational field strength. The analysis is approached from a flow field perspective. Flow is proportional to the shear exerted on a structure which maintains position within the field. The equations are solved for the deviation of a particle from its original position in a circular streamline as a function of time. The radial deviation is important for defining the operating limits and dimensions of the vessel because of the finite radius at which particles necessarily intercept the wall. This analysis uses a rotating reference frame concept. Author

N92-13085# Joint Publications Research Service, Arlington, VA.
ALTERNATIVE PROPOSAL FOR SPACE PRODUCTION, POLYUS MODULE LAUNCH REVEALED
Dmitriy Alekseyevich Polukhin *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 39-40 Transl. into ENGLISH from Pravda, Moscow (USSR), 17 May 1990 p 3 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-13341# Department of Energy, Washington, DC. Office of Quality Programs.
DOE EXPLOSIVES SAFETY MANUAL
May 1990 102 p Revised Prepared in cooperation with Lawrence Livermore National Lab., CA
(Contract W-7405-eng-48)
(DE90-011319; DOE/EV-06194/3-Rev-5) Avail: NTIS HC/MF A06

The Department of Energy (DOE) policy requires that all activities be conducted in a manner that protects the safety of the public and provides a safe and healthful workplace for employees. DOE has also prescribed that all personnel be protected in any explosives operation undertaken. The level of safety provided shall be at least equivalent to that of the best industrial practice. The risk of death or serious injury shall be limited to the lowest practicable minimum. DOE and contractors shall continually review their explosives operations with the aim of achieving further refinements and improvements in safety practices and protective features. This manual describes the Department's explosive safety requirements applicable to operations involving the development, testing, handling, and processing of explosives or assemblies containing explosives. It is intended to reflect the state-of-the-art in explosives safety. In addition, it is essential that applicable criteria and requirements for implementing this policy

be readily available and known to those responsible for conducting DOE programs. This document shall be periodically reviewed and updated to establish new requirements as appropriate. Users are requested to submit suggestions for improving the DOE Explosives Safety Manual through their appropriate Operations Office to the Office of Quality Programs. DOE

N92-13342*# Fairchild Space Co., Germantown, MD.
SUMMARY OF MISCELLANEOUS HAZARD ENVIRONMENTS FOR HYPOTHETICAL SPACE SHUTTLE AND TITAN IV LAUNCH ABORT ACCIDENTS Final Report
M. Eck and M. Mukunda Dec. 1989 83 p
(Contract JPL-957524)
(NASA-CR-189444; NAS 1.26:189444; FSC-ESD-217-89-457)
Avail: NTIS HC/MF A05 CSCL 13B

The various analyses described here were aimed at obtaining a more comprehensive understanding and definition of the environments in the vicinity of the Radioisotope Thermal Generator (RTG) during certain Space Transportation System (STS) and Titan IV launch abort accidents. Addressed here are a number of issues covering explosion environments and General Purpose Heat Source Radioisotope Thermoelectric Generator (GPHS-RTG) responses to those environments. Author

N92-13343*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A NONLINEAR ESTIMATOR FOR RECONSTRUCTING THE ANGULAR VELOCITY OF A SPACECRAFT WITHOUT RATE GYROS
M. E. Polites and W. D. Lightsey Washington Dec. 1991 24 p
(NASA-TP-3178; M-675; NAS 1.60:3178) Avail: NTIS HC/MF A03 CSCL 13B

A scheme for estimating the angular velocity of a spacecraft without rate gyros is presented. It is based upon a nonlinear estimator whose inputs are measured inertial vectors and their calculated time derivatives relative to vehicle axes. It works for all spacecraft attitudes and requires no knowledge of attitude. It can use measurements from a variety of onboard sensors like Sun sensors, star trackers, or magnetometers, and in concert. It can also use look angle measurements from onboard tracking antennas for tracking and data relay satellites or global positioning system satellites. In this paper, it is applied to a Sun point scheme on the Hubble Space Telescope assuming all or most of its onboard rate gyros have failed. Simulation results are presented for verification. Author

N92-13344# David Taylor Research Center, Bethesda, MD. Ship Materials Engineering Dept.
AN INTELLIGENT CONTROL STRATEGY FOR THE SPRAY FORMING PROCESS Research and Development Report, Apr. - Jun. 1991
Angela L. Moran, Craig J. Madden, M. A. Matteson, Jr., Paul Kelley, and Dawn White Jun. 1991 19 p
(AD-A241290; DTRC-SME-91-52) Avail: NTIS HC/MF A03 CSCL 12/2

A control system incorporating a fuzzy logic inference engine and optical sensors has been developed for the spray forming facility at the David Taylor Research Center. An imaging system employing laser illumination and a high speed CCD camera provides critical on-line preform surface roughness and rate of growth information. A fuzzy logic controller utilizes a rule set to translate visual information into a form that can be reviewed by the conditional statements of the rule base. A high performance manipulator and motion controller have also been incorporated into the spray forming system. This discussion includes development of optical sensors and integration of advanced control systems to determine and activate required corrective actions to the spray forming process parameters. GRA

N92-13345# Oak Ridge National Lab., TN.
A COMPUTER MODEL FOR SIMULATION OF ABSORPTION SYSTEMS IN FLEXIBLE AND MODULAR FORM
G. Grossman, K. Gommed, and D. Gadoth Aug. 1991 117 p Prepared in cooperation with Technion - Israel Inst. of Tech., Haifa
(Contract DE-AC05-84OR-21400)
(DE92-000384; ORNL/Sub-90-89673) Avail: NTIS HC/MF A06

A computer code in a flexible and modular form developed for simulation of absorption systems makes it possible to investigate various cycle configurations with different working fluids. The code is based on unit subroutines containing the governing equations for the system's components. The equations are linked by a main program according to the user's specifications to form the complete system. The equations are solved simultaneously, and fluid properties are taken from a property data base. The code is user oriented and requires a relatively simple input containing the given operating conditions and the working fluid at each state point. The user conveys to the computer an image of his or her cycle by specifying the different subunits and their interconnection. Based on this information, the program calculates: (1) the temperature, flow rate, concentration, pressure, and vapor fraction at each state point in the system; and (2) the heat duty at each unit, from which the coefficient of performance may be determined. The program has been used successfully to simulate a variety of single-stage, double-stage, and dual-loop heat pumps and heat transformers, with the working fluids LiBr-H2O,H2O-NH3, LiBr/H2O-NH3, LiBr/ZnBr2-CH3OH, and more. DOE

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-13346*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
FEASIBILITY STUDY OF A SYNTHESIS PROCEDURE FOR ARRAY FEEDS TO IMPROVE RADIATION PERFORMANCE OF LARGE DISTORTED REFLECTOR ANTENNAS Semiannual Status Report
W. L. Stutzman, K. Takamizawa, P. Werntz, J. LaPean, R. Barts, and B. Shen Aug. 1991 48 p
(Grant NAG1-859)
(NASA-CR-188797; NAS 1.26:188797; SATCOM-91-5) Avail: NTIS HC/MF A03 CSCL 20N

Virginia Tech is involved in a number of activities with NASA Langley related to large aperture radiometric antenna systems. These efforts are summarized and the focus of this report is on the feasibility study of a synthesis procedure for array feeds to improve radiation performance of large distorted reflector antennas; however, some results for all activities are reported. Author

N92-13347 Illinois Univ. at Urbana-Champaign, Savoy.
INVESTIGATION OF TOPICS IN RADAR SIGNAL PROCESSING Ph.D. Thesis
Orhan Arikan 1990 104 p
Avail: Univ. Microfilms Order No. DA9114164

A promising image reconstruction algorithm proposed by W. Lawton for spotlight-mode synthetic aperture radar (SAR) is studied. The spatial domain image is produced through a series of convolutions and DFTs, all performed using FFTs. It is shown that the algorithm implements a form of trapezoidal-to-Cartesian interpolation followed by an FFT. A simplified back-projection algorithm is proposed for spotlight-mode SAR in which the filtered projections are obtained automatically by choosing the radar waveform to be the impulse response of the desired filter. The filtering is accomplished through the physical mechanism of the waveform reflecting off the target, which is described by a convolution. A parallel architecture is described for the back-projection of the filtered projections and its computational

and memory requirements are analyzed. A basic derivation is given of bistatic spotlight-mode SAR (BSSAR). It is shown that BSSAR can be explained using the projection-slice theorem from computed tomography. The locations were found of the Fourier domain samples and examine the shape of the Fourier grid for several special cases of transmitter and receiver motions. The chirp-z interpolation algorithm, which is a promising approach to interpolation between two uniform grids with arbitrary spacings is considered. The least squares ambiguity function synthesis problem was studied, which has applications in range-Doppler radar imaging and time-frequency signal analysis. The solution is presented for least squares ambiguity function synthesis both in the continuous and discrete time-frequency domains. Dissert. Abstr.

N92-13348*# Ohio State Univ., Columbus. ElectroScience Lab.
ENGINEERING CALCULATIONS FOR COMMUNICATIONS SATELLITE SYSTEMS PLANNING Final Report
E. Walton, E. Aebker, F. Mata, and C. Reilly May 1991 78 p
(Grant NAG3-159)
(NASA-CR-189458; NAS 1.26:189458; OSU-723160-1) Avail: NTIS HC/MF A05 CSCL 17B

The final phase of a satellite synthesis project is described. Several methods for generating satellite positionings with improved aggregate carrier to interference characteristics were studied. Two general methods for modifying required separation values are presented. Also, two methods for improving aggregate carrier to interference (C/I) performance of given satellite synthesis solutions are presented. A perturbation of the World Administrative Radio Conference (WARC) synthesis is presented. Author

N92-13349*# Howard Univ., Washington, DC. Center for Systems Engineering and Computing.
ENGINEERING TECHNOLOGY FOR NETWORKS Progress Report, 1 Feb. - 31 Jul. 1991
Arthur S. Paul and Norman Benjamin 31 Jul. 1991 151 p
(Grant NAG5-995)
(NASA-CR-189480; NAS 1.26:189480) Avail: NTIS HC/MF A08 CSCL 17B

Space Network (SN) modeling and evaluation are presented. The following tasks are included: Network Modeling (developing measures and metrics for SN, modeling of the Network Control Center (NCC), using knowledge acquired from the NCC to model the SNC, and modeling the SN); and Space Network Resource scheduling. Author

N92-13350# Naval Postgraduate School, Monterey, CA.
PERFORMANCE ANALYSIS OF HIGH FREQUENCY SINGLE-SITE-LOCATION ANTENNA ARRAYS USING NUMERICAL ELECTROMAGNETIC MODELING M.S. Thesis
Harry T. Schiantarelli Sep. 1990 25 p
(AD-A240868) Avail: NTIS HC/MF A03 CSCL 17/4

Electronic support measures (ESM) systems play an increasingly important role in modern warfare and can influence the outcome of a military engagement. The application of ESM can be extended to anti-guerrilla and anti-drug operations where law enforcement agencies can exploit the fact that their presence is inducing the outlaw to depend more on radio communications to coordinate their activities. When a propagation path of no more than one reflection at the ionosphere (1-hop) can be assumed, position of an HF emitter can be determined by a single observing site using vertical triangulation, provided that the height of the ionosphere at the point where the radio wave is reflected, can be determined. This technique is known as high frequency direction finding single-site-location (HFDF SSL). This thesis analyzes the HFDF SSL error in measuring the direction of arrival of the signal, how this error is generated by the antenna array and its effect on emitter location. The characteristics of the two antenna arrays used by a specific HFDF SSL system that implements the phase-interferometer techniques were studied using electromagnetic modeling. GRA

N92-13351# Institute for Defense Analyses, Alexandria, VA.
MODELING RADAR CLUTTER Final Report, Jul. 1990 - May 1991
David A. Sparrow May 1991 37 p
(Contract MDA903-89-C-0003)
(AD-A240965; IDA-P-2464; IDA/HQ-90-35838; AD-E501424)
Avail: NTIS HC/MF A03 CSCL 17/9

Radar detection of aircraft on a particular scan depends in large measure on the clutter return from the target's range cell. The distribution of clutter reflectivities is often so wide that variations of many dB in signature or threshold of detection correspond to changes of only a few percent in PD (probability of detection). Thus, where clutter variability is large, it must be included to avoid errors. However, large clutter variability when included will tend to overwhelm the uncertainties from other sources such as human performance. This may allow simplified treatment of these other sources. We find that the broad distribution of radar returns from environmental features leads to clutter limited detection probabilities that approach unity slowly as range decreases, rather than abruptly as in the noise limited case. GRA

N92-13352# Colorado School of Mines, Golden. Center for Wave Phenomena.
THE CAGNIARD METHOD IN COMPLEX TIME REVISITED Technical Report, 1 Oct. 1990 - 30 Sep. 1991
Norman Bleistein and Jack K. Cohen 4 Apr. 1991 49 p
(Contract N00014-91-J-1267)
(AD-A241004; CWP-098P) Avail: NTIS HC/MF A03 CSCL 12/2

The Cagniard-de Hoop method is ideally suited to the analysis of wave propagation problems in stratified media. The method applies to the integral transform representation of the solution in the transform variables (s,p) dual of the time and transverse distance. The objective of the method is to make the p-integral take the form of a forward Laplace transform, so that the cascade of the two integrals can be identified as a forward and inverse transform, thereby making the actual integration unnecessary. Typically, the method is applied to an integral that represents one body wave plus other types of waves. In this approach, the saddle point of w(p) that produces the body wave plays a crucial role because it is always a branch point of the integrand. Furthermore, the paths of steepest ascent from the saddlepoint are always the tails of the Cagniard path. GRA

N92-13353# Naval Postgraduate School, Monterey, CA.
MOVING OBJECT DETECTION BY TRACK ANALYSIS M.S. Thesis
Chen-Shan Wang Sep. 1990 87 p
(AD-A241007) Avail: NTIS HC/MF A05 CSCL 17/11

The purpose of this thesis is to study the Hough transform method, as applied to the detection of tracks of underwater moving objects in Lofargrams. The subjects included are the Hough transformation, clustering study, and reconstruction. Two methods, LAS (Land Analysis System) cluster technique and Sorting, are used for cluster analysis. Encouraging results are obtained from the Sorting method. A further improvement of the Sorting is shown to yield better results in processing noisy track data. Experimental results dealing with noise free artificial data, noisy artificial data, and real noisy data are presented. The improved Sorting technique presented in the thesis has shown improvements compared to the straight forward Sorting when it is applied to spectral component tracking. GRA

N92-13354# Naval Postgraduate School, Monterey, CA.
NATURAL RESONANCE EXTRACTION AND ANNIHILATION FILTERING METHODS FOR RADAR TARGET IDENTIFICATION M.S. Thesis
Timothy J. Murphy Sep. 1990 120 p
(AD-A241038) Avail: NTIS HC/MF A06 CSCL 17/9

This thesis represents an initial attempt to demonstrate aspect independent target identification of complex radar targets using annihilation filters based on the natural resonances of the targets.

The Cadzow-Solomon signal processing algorithm is tested to determine its suitability for the task of extracting the poles from complex targets to a degree of accuracy required for successful implementation of an annihilation filtering target identification system. This testing was conducted through the use of noise polluted synthetic data as well as measured transient scattering data from thin-wire and silver coated scale model aircraft targets. The testing revealed that the Cadzow-Solomon algorithm can return pole clusters at false pole locations when processing the scattered returns from complex targets. Properties of annihilation filters which may affect their ability to discriminate complex targets are examined. GRA

N92-13355# Naval Postgraduate School, Monterey, CA.
APPLICATION OF MULTI-FREQUENCY MODULATION (MFM) FACSIMILE MACHINES M.S. Thesis
James T. Nickerson Sep. 1990 53 p
(AD-A241041) Avail: NTIS HC/MF A04 CSCL 12/9

Multi-Frequency Modulation (MFM) has been developed at NPS using both differential quadrature-amplitude-modulation (DQAM) and differential quadrature-phase-shift-keying (DQPSK) encoding formats. This report discusses the use of each of these formats in transmitting a facsimile encoded message over a voice frequency channel. The satisfactory transmission and receipt of facsimile messages was achieved using both DQPSK and D16-QAM encoding formats. Research and testing for this report included the use of variable facsimile transmission rates in an attempt to optimize MFM operating parameters. Experimental results revealed a higher error rate when decoding messages contained similar contiguous characters. GRA

N92-13356# Naval Postgraduate School, Monterey, CA.
RADAR TARGET CLASSIFICATION BY NATURAL RESONANCES: SYSTEM ANALYSIS M.S. Thesis
Peter C. Reddy Sep. 1990 148 p
(AD-A241170) Avail: NTIS HC/MF A07 CSCL 17/9

This thesis examines the system implementation considerations of a resonance based radar target classification system. The basis of the system is the aspect and excitation independent property of electromagnetic scattering from a conducting body. Such a system consists of two components: pole extraction and annihilation filtering. The algorithms investigated here for these purposes are the Cadzow-Solomon pole extraction algorithm and the K-Pulse annihilation filter. Additionally, an aspect-dependent annihilation filter based on an inverse autoregressive moving average (ARMA) model is introduced. The procedures are applied to noise polluted synthetic data, as well as scattering data collected for a thin-wire and silver coated 1/72 scale model aircraft.
Author (GRA)

N92-13357# Naval Research Lab., Washington, DC.
SCHEDULING LINK ACTIVATION IN MULTIHOP RADIO NETWORKS BY MEANS OF HOPFIELD NEURAL NETWORK TECHNIQUES Memorandum Report, Jul. 1990 - Apr. 1991
Craig M. Barnhart, Jeffrey E. Wieselthier, and Anthony Ephremides 3 Sep. 1991 99 p
(Proj. RR02105)
(AD-A241242; NRL-MR-6885) Avail: NTIS HC/MF A05 CSCL 25/2

We address the problem of link activation or scheduling in multihop packet radio networks, a contention-free form of channel access that is appropriate for many military communication applications. It is well known that this problem, in almost all of its forms, is a combinatorial-optimization problem of high complexity. We approach this problem by use of a Hopfield neural network model in which the method of Lagrange multipliers is used to vary dynamically the values of the coefficients used in the connection weights. Two forms of the scheduling problem are considered. In the first, communication requirements are specified in terms of the number of packets that must be transmitted over each link in the network. In the second, an additional constraint is incorporated, namely that the sequence of link activations along any multihop path must be preserved. Extensive software simulation results demonstrate the effectiveness of this approach in producing schedules of optimal length. Issues associated with the extension of this approach to the joint routing/scheduling problem are discussed. Author (GRA)

N92-13358# Naval Research Lab., Washington, DC.
PULSE COMPRESSION DEGRADATION DUE TO OPEN LOOP ADAPTIVE CANCELLATION. PART 2 Interim Report
Karl Gerlach 23 Aug. 1991 19 p
(AD-A241288; NRL-9309-Pt-2) Avail: NTIS HC/MF A03 CSCL 17/4

An exact expression for the perturbed sidelobe level of a compressed pulse that has been preprocessed through an adaptive canceller has been derived in Part 1. This exact expression requires computer assistance to be evaluated. This report derives a rule of thumb expression that is a good approximation for the canceller noise power level that is induced by having a desired signal present in the canceller weight calculation. An expression for the number of independent samples necessary to equalize the signal-induced power with the quiescent interference level is derived. GRA

N92-13359# Naval Postgraduate School, Monterey, CA.
CONFERENCE PROCEEDINGS: 7TH ANNUAL REVIEW OF PROGRESS IN APPLIED COMPUTATIONAL ELECTROMAGNETICS AT THE NAVAL POSTGRADUATE SCHOOL
Mar. 1991 720 p Conference held in Monterey, CA, 18-22 Mar. 1991
(AD-A241323) Avail: NTIS HC/MF A99 CSCL 20/3

Topics covered include User Interfaces and PC Applications for EM Modeling Codes; Caeme Special Session on Computer Applications in Electromagnetic Education; Inverse Problem Solutions; Asymptotic Solutions; New Techniques; Finite Element and Finite Difference Frequency Domain Solutions; Moment Method Theory; Modeling EM Interactions in Materials; High Frequency Applications and Wire Grid Modeling Techniques; Microwave Circuits and Microstrip Antenna Analysis; Antenna Analysis; NEC Antenna Analysis; Electromagnetic Compatibility (EMC); Low Frequency Applications; Time Domain Methods; Transmission Line Matrix (TLM) Time Domain Applications; Finite Element and Finite Difference Time Domain Solutions. GRA

N92-13360# Army Electronic Proving Ground, Fort Huachuca, AZ.
METHODOLOGY INVESTIGATION. PHASE 1: COMPACT RANGE TEST APPLICATIONS
Francis L. Davis Aug. 1991 269 p
(AD-A241480; USAEPG-FR-1406) Avail: NTIS HC/MF A12 CSCL 14/2

Results of initial testing performed on the outdoor compact range located at the U.S. Army Electronic Proving Ground, Fort Huachuca, Arizona are reported. The compact range is an instrument for testing antenna radiation patterns and gain. It employs a large parabolic reflector to collimate radio frequency energy to provide an area in which the wavefronts are nearly perfectly parallel. This area, in which tests may be performed, is known as the quiet zone. The advantage of this type of range over so-called near-field ranges, which cannot correct the curvature of the wavefronts, is increased accuracy at microwave frequencies, and reduced phase error. The report states that the USAEPG compact range is ready for general use testing antennas in the 6- to 40-GHz range. The report calls for investigations into the range's usefulness for measuring radar cross sections, and providing unusually large and uniform electromagnetic fields for tests of electromagnetic interference (EMI) characteristics. Author (GRA)

N92-13361# Naval Ocean Systems Center, San Diego, CA.
RAYTRACE TECHNIQUE FOR A LATERALLY HETEROGENEOUS ENVIRONMENT: SOFTWARE DOCUMENT Final Report
W. L. Patterson 30 Sep. 1990 39 p
(AD-A241589; NOSC/TD-2139) Avail: NTIS HC/MF A03 CSCL 20/15

Electromagnetic (EM) wave propagation is the transmission of an EM wave between a transmitter and a receiver. If a particular point on the wave front is followed over time, the collection of point positions would define a ray. The ray would coincide with a line from the transmitter to the receiver. The purpose of this raytrace technique is to describe an EM wave's path in terms of rays, as the wave propagates through a laterally heterogeneous medium where the index of refraction is allowed to vary both vertically and horizontally. GRA

N92-13362# Naval Ocean Systems Center, San Diego, CA.
MODELING OF FORWARD SCATTERING Final Report, Oct. 1990 - Apr. 1991
G. A. Lengua Apr. 1991 22 p
(AD-A241618; NOSC-TD-2135) Avail: NTIS HC/MF A03 CSCL 17/7

Since forward scattering should be best simulated with a point-scatterer model through the use of specular point theory, a derivation of the theory from the Helmholtz integral formulation is presented and attendant approximations noted. All hold reasonably well for most cases of interest, and produce only minor errors with respect to exact results. Several implementation issues are discussed. A simple way to realize the point-scatterer model is through the partition of the surface into correlation areas and the probabilistic assignment of specular points. Detailed examination of ping-to-ping fluctuations, or the effects of higher order statistics, requires generation of surfaces with a desired roughness spectrum. A procedure to realize this is presented. GRA

N92-13363# Naval Coastal Systems Center, Panama City, FL.
ELECTROMAGNETIC FIELDS OF A UNIFORM SPHERE IN A UNIFORM CONDUCTING MEDIUM WITH APPLICATION TO DIPOLE SOURCES
W. M. Wynn Sep. 1991 84 p
(AD-A241627; NCSC-TR-426-90) Avail: NTIS HC/MF A05 CSCL 20/5

Vector spherical harmonic expansions are developed for the electromagnetic field of a uniform sphere in a uniform conducting medium in the presence of an arbitrary localized distribution of current. The source is either interior to or exterior to the sphere. Explicit expressions then are developed for all cases for magnetic and current dipole sources, and a complete numerical treatment is given for the case of exterior dipole and field point. The general treatment includes the transverse electric-transverse magnetic representation of the electromagnetic field in a source-free region, and demonstration of the formation of the electric and magnetic field vectors from E x r and B x r alone. General expressions are given relating the scattered field expansion coefficients to the source expansion coefficients, including the special case of a perfectly conducting sphere. The specialized treatment of dipole sources includes explicit expressions for the electric and magnetic field components both interior to and exterior to the sphere, for either internal or external dipoles, for the general ac case and for the dc limit. The detailed treatment of the dipole sources includes various series and asymptotic representations of the Bessel functions which are incorporated into Hewlett-Packard Basic 3.0 codes for the calculation of the dipole field components for the ac and dc cases for exterior dipole and field point. GRA

N92-13364# Naval Research Lab., Washington, DC.
ELECTROMAGNETIC INSTABILITY OF AN INTENSE BEAM IN A QUADRUPOLE FOCUSING SYSTEM
Cha-Mei Tang, Thomas Swyden, and Jonathan Krall 4 Oct. 1991 6 p
(AD-A241632; NRL-MR-6879) Avail: NTIS HC/MF A02 CSCL 20/15

Discrete quadrupole focusing systems are subject to the electromagnetic instability previously found in helical quadrupole strong focusing systems. The dispersion relation is derived. Analytical growth rates are obtained. Instability boundaries are established. Numerical solutions of the dispersion relation results show that the overall stability properties are not favorable for long pulse, high-current electron beams. GRA

N92-13365# Naval Research Lab., Washington, DC.
A NEW THEORY FOR IMAGE FORMATION WITH QUASI-HOMOGENEOUS SOURCES AND ITS APPLICATION TO THE DETECTION AND LOCATION OF ICBM LAUNCHES
W. H. Carter 17 Sep. 1991 27 p
(AD-A241633; NRL-9336) Avail: NTIS HC/MF A03 CSCL 17/7

A new theory describing image formation with three dimensional, quasi-homogeneous primary sources is developed for application to the problem of detecting and locating ICBM launches. The theory is used to compare telescopes and interferometers that have been suggested for use in Brilliant Eyes systems. GRA

N92-13366# Naval Research Lab., Washington, DC.
CONTRIBUTIONS TO RADAR TRACKING ERRORS FOR A TWO-POINT TARGET CAUSED BY GEOMETRIC APPROXIMATIONS Final Report, 1989-1991
Eric L. Mokole 19 Sep. 1991 27 p
(AD-A241635; NRL-9349) Avail: NTIS HC/MF A03 CSCL 17/9

Expressions for the exact range and angular errors between the apparent (measured) and and actual location of a two-point target are obtained. The difference between the exact errors and two distinct sets of approximation to them are examined as a function of the ratio of the distance from a monostatic radar to the centroid of the scatterers. One set of approximations to the errors is found in the literature and is apparently the far field supposition of parallel line propagation paths between points on the target and the radar's aperture. The other set results from expanding appropriate parts of the exact errors in infinite series about the aforementioned ratio and then truncating the various series. The advantages and shortcomings of each set of approximations are identified. The exact expression for the angular error is shown to reduce to both approximations when certain assumptions are made; however, such is not the case for the transverse and radial range errors. GRA

N92-13367*# New Mexico State Univ., Las Cruces. Dept. of Electrical and Computer Engineering.
INVESTIGATION OF BANDWIDTH-EFFICIENT CODING AND MODULATION TECHNIQUES Semiannual Status Report, Jul. 1991 - Jan. 1992
William P. Osborne 1992 19 p
(Grant NAG5-1392)
(NASA-CR-188631; NAS 1.26:188631) Avail: NTIS HC/MF A03 CSCL 20N

The necessary technology was studied to improve the bandwidth efficiency of the space-to-ground communications network using the current capabilities of that network as a baseline. The study was aimed at making space payloads, for example the Hubble Space Telescope, more capable without the need to completely redesign the link. Particular emphasis was placed on the following concepts: (1) what the requirements are which are necessary to convert an existing standard 4-ary phase shift keying communications link to one that can support, as a minimum, 8-ary phase shift keying with error corrections applied; and (2) to determine the feasibility of using the existing equipment configurations with additional signal processing equipment to realize the higher order modulation and coding schemes. Author

N92-13860*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
FURTHER EVALUATION OF THE CONSTRAINED LEAST SQUARES ELECTROMAGNETIC COMPENSATION METHOD
William T. Smith *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 206-209 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20N

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N92-13368# Sandia National Labs., Albuquerque, NM.
STANDARDIZED COMMUNICATION SYMBOLS TO FACILITATE CIRCUIT DESIGN
M. George and L. G. Pierson May 1990 45 p
(Contract DE-AC04-76DP-00789)
(DE90-012011; SAND-90-0283) Avail: NTIS HC/MF A03

In the course of communication circuit design at Sandia National Laboratories, a set of communication symbols was created to aid, and hopefully standardize, the design process. These symbols, which allow the designer to build a circuit using black boxes, simplify circuit design and documentation. They also provide a standard set to help minimize interpretation problems among circuit designers. The symbols can be used to represent various devices in a circuit, such as modems, computers, terminals, encryption devices, converters, etc. When using these symbols to design communication circuits, the contours of each symbol show which devices interface together. Mismatch device contours indicate the need for another element (such as a null modem) between the two devices. In addition, the propagation of clock, data, and control signals through the circuit can be represented. Clocking modes on synchronous components (modems, multiplexers, etc.) and signal line crossovers can also be determined from the drawings during the design process. DOE

N92-13369# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
MOLTEN CARBONATE FUEL CELL POWER GENERATION SYSTEM TEST FACILITY
Takao Watanabe, Yoshiyuki Izaki, Takao Hayasaka, Nagayuki Horiuchi, Teruo Hamamatsu, and Hiroshi Ishikawa May 1989 41 p In JAPANESE; ENGLISH summary
(DE90-503440; CRIE-W-88030) Avail: NTIS (US Sales Only) HC A03

CRIEPI has installed the Molten Carbonate Fuel Cell (MCFC) Power Generation System Test Facility which can be used for the tests of the MCFC subsystem. The purpose of this facility installation are as follows: (1) to clarify the large stack performance and to evaluate the large stack durability; and (2) to develop the operation technology of the MCFC which is installed within the system. The facility is divided into two sections, the single loop and the recycle loop. Before power generation tests using MCFC stacks, CRIEPI checked the performance of the facility and ensured that the two loops have the preferable performance. DOE

N92-13370# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
METHOD FOR DIAGNOSING THE INSULATION DETERIORATION IN MICA-RESIN INSULATED STATOR WINDINGS OF GENERATOR
Yasuyuki Ikeda and Hiromasa Fukagawa Jun. 1989 36 p In JAPANESE; ENGLISH summary
(DE90-503991; CRIE-W-88046) Avail: NTIS (US Sales Only) HC A03

For the purpose of establishing a deterioration criterion required for diagnosing the insulation deterioration of synthetic resin insulated windings of generators, data concerning the correlation between the nondestructive measurements of insulation characteristics and dielectric breakdown voltages of windings in operation were examined and collected. Coil samples were removed, and accelerated deterioration tests of model coils were carried out. The results from this investigation are presented. DOE

N92-13371*# Old Dominion Univ., Norfolk, VA.
ATAMM ANALYSIS TOOL Report, 1 Jun. 1989 - 31 May 1990
Robert Jones, John Stoughton, and Roland Mielke Oct. 1991 107 p
(Contract NCC1-136)
(NASA-CR-187625; NAS 1.26:187625) Avail: NTIS HC/MF A06 CSCL 09B

Diagnostics software for analyzing Algorithm to Architecture Mapping Model (ATAMM) based concurrent processing systems is presented. ATAMM is capable of modeling the execution of large grain algorithms on distributed data flow architectures. The tool graphically displays algorithm activities and processor activities for evaluation of the behavior and performance of an ATAMM based system. The tool's measurement capabilities indicate computing speed, throughput, concurrency, resource utilization, and overhead. Evaluations are performed on a simulated system using the software tool. The tool is used to estimate theoretical lower bound performance. Analysis results are shown to be comparable to the predictions. Author

N92-13372# Sandia National Labs., Albuquerque, NM.
RADLAC 2 PERFORMANCE SUMMARY
S. L. Shope, M. G. Mazarakis, C. A. Frost, C. E. Crist, J. W. Poukey, K. R. Prestwich, B. N. Turman, K. Struve, and D. Welch 1991 4 p Presented at the 1991 Annual Charged Particle Beam Review, Beltsville, MD, 25-29 Jul. 1991
(DE91-018812; SAND-91-1975C; CONF-9107177-1) Avail: NTIS HC/MF A01

A 12.5-m long Self Magnetically Insulated Transmission LinE (SMILE) that sums the voltages of eight, 2-MV pulse forming lines was installed in the RADLAC-2 linear introduction accelerator. The magnetic insulation criteria were calculated using parapotential flow theory and found to agree with MAGIC simulations. High quality annular beams with a transverse velocity beta (perpendicular) equals v(perpendicular)/c is less than or equal to 0.1 and a radius r(sub b) less than 2 cm were measured for currents of 50 to 100 kA extracted from a magnetic immersed foilless diode. These parameters were achieved with 11 to 15-MV accelerating voltages and 6 to 16-kG diode magnetic fields. The experimental results exceeded our design expectations and are in good agreement with code simulations. DOE

N92-13373# Rochester Univ., NY. Lab. for Laser Energetics.
INVESTIGATION OF SURFACE BREAKDOWN ON SEMICONDUCTOR DEVICES USING OPTICAL PROBING TECHNIQUES Final Report
William R. Donaldson 1990 68 p
(Contract N00014-88-K-0583)
(AD-A240825) Avail: NTIS HC/MF A04 CSCL 09/5

An extremely attractive feature of photoconductive switches is that they can be used at fairly high voltages (multikilovolts). The speed and high voltages handling capability of photoconductive switches is superior to that of any other device. A 100-kV, 80-MW, laser-activated photoconductive power switch has been successfully operated. Photoconductive switches are particularly useful for applications that require precise timing of high-voltage electrical signals with optical signals. High-power electrical pulses with picosecond rise times can be generated that are synchronous to picosecond optical pulses. The first applications of high-power, picosecond, photoconductive switching were for use in the laser fusion facility at the Laboratory for Laser Energetics (LLE) of the University of Rochester. A completely optoelectronic prepulse suppression scheme based on photoconductive switches was used with LLE's OMEGA laser system. GRA

N92-13374# Westinghouse Defense and Electronic Systems Center, Baltimore, MD.
SUPERCONDUCTING MATCHING NETWORKS IN MONOPOLE ANTENNAS Final Report, 1 Aug. 1989 - 31 Jul. 1991
A. Y. Piatnicia, S. H. Talisa, M. J. Buckley, J. R. Gavaler, and M. A. Janocko Aug. 1991 59 p
(Contract N00014-89-C-0180)
(AD-A240871) Avail: NTIS HC/MF A04 CSCL 09/1

The goals of this program were to demonstrate the performance advantages of UHF Super Directive Array using a monopole antenna matching network made of high temperature superconducting (HTS) material over a monopole antenna matching network made of gold and to demonstrate the feasibility of using HTS material matching networks to feed a two element electrically small superdirective monopole array. In both cases only the matching networks were made of HTS material. The radiators were made of silver, copper, and steel. The electrically small monopole antenna and the electrically small element monopole antenna array were operated in the UHF band because the need exists for a high efficiency electrically small array operating in the UHF range as part of a multispectral seeker of an air-to-air missile. To date no antenna system consisting of electrically small conventional metal monopole radiators and HTS material matching networks has been demonstrated. An electrically small superdirective monopole array with superconducting matching networks is a candidate for use in an air-to-air missile as part of a multispectral seeker. The seeker must have a multispectral capability in order to successfully engage advanced Low Observable aircraft and missiles. The air-to-air missile guidance is initially provided by a surveillance and control aircraft. GRA

N92-13375# Naval Postgraduate School, Monterey, CA.
CIRCUIT MODELS FOR A MILLIMETER-WAVE SUSPENDED-MICROSTRIP LINE DISCONTINUITY M.S. Thesis
Won T. Jin Sep. 1990 73 p
(AD-A240906) Avail: NTIS HC/MF A04 CSCL 09/1

The goal of this work is to develop an equivalent circuit model for a typical discontinuity in shielded suspended substrate line, in particular, the step-change in width. This circuit model is needed for use in CAD analysis of microwave systems using the suspended stripline transmission mode. Author (GRA)

N92-13376# Pennsylvania State Univ., University Park. Materials Research Lab.
RELAXOR FERROELECTRICS FOR ELECTROSTRICTIVE TRANSDUCERS: ELECTROSTRICTIVE STRAIN/DIELECTRIC PROPERTIES OF RELAXOR FERROELECTRICS Quarterly Report
1991 18 p
(Contract N00014-90-J-4077)
(AD-A241019) Avail: NTIS HC/MF A03 CSCL 09/1

The electrostrictive actuator and nonresonant transducer capabilities of relaxor ferroelectrics have been of practical interest for the last decade. Displacement transducers from materials which have large electrostrictive effects are advantageous for several reasons: (1) The field-induced deformations (strains) are more stable than in piezoelectric ceramics (relaxation processes are minor and they do not evidence aging from macrodomain-defect interactions), (2) Hysteresis in the strain-field dependence is reduced over a wide temperature range-- the original dimension is returned to rapidly after removal of the polarizing field (reduced creep and strain offset), and (3) Thermal expansion effects are quite small in the relevant temperature range of maximum dielectric permittivity. GRA

N92-13377# Massachusetts Inst. of Tech., Cambridge. Materials Processing Center.
ELECTROCHEMICALLY MODULATED SUPERCONDUCTIVITY Final Report
Donald R. Sadoway and Robert M. Rose 27 Aug. 1991 10 p
(Contract N00014-89-K-0108)
(AD-A241202) Avail: NTIS HC/MF A02 CSCL 09/1

The goal of the project is to test the feasibility of electrochemically modulated superconductivity in the cuprate superconductors. Such a test is possible because the new high temperature superconductors are ionic solids that are extremely sensitive to oxygen potential. Passive optimization of the latter is impossible, not only because of materials processing limitations but also due to thermodynamic and structural instabilities. Our approach is active intervention by electrochemical means, in other words, electrochemical polarization while the material is actually or potentially in the superconducting state. This is possible only by the use of electrolytes that are functional at cryogenic temperatures. Several years ago we discovered cryogenic electrolysis and demonstrated the existence of such electrolytes. Success in this effort would make possible a new class of electronic and photonic devices that exploit the capability to control actively the transition into and out of the superconducting state while the material is in service. GRA

N92-13378# SRI International Corp., Menlo Park, CA.
WORK DEVELOPMENT AND APPLICATION OF ADVANCED METHODS IN ELECTRONIC STRUCTURE TO SEMICONDUCTORS
13 Sep. 1991 12 p
(Contract N00014-89-K-0132)
(AD-A241253) Avail: NTIS HC/MF A03 CSCL 09/1

Work so far falls into a number of groups: (1) continuation of the Schottky barrier studies; (2) work on early stages of Schottky barrier formation (with John Klepeis: (3) work on properties of SiC with Walter Lambrecht and Ben Segall at Case; (4) general development of the methods, most particularly the ultimate electronic structure program that I've designed together with Michael Methfessel in Berlin; and (5) current projects, and plans for the near future. GRA

N92-13379 Department of the Navy, Washington, DC.
RESISTIVE ELEMENT USING DEPLETION-MODE MOSFETS Patent
Patrick A. Shoemaker, inventor (to Navy) 23 Apr. 1991 6 p
Filed 30 Mar. 1990
(AD-D014991; US-Patent-5,010,385; US-Patent-Appl-SN-502701; US-Patent-Class-357-41) Avail: US Patent and Trademark Office CSCL 09/1

The present invention provides a linear resistance element comprising a pair of transistors. The transistor pair includes first and second depletion-type field effect transistors each having a gate, a source electrode, a drain electrode, a channel mobility, and a threshold voltage. The source and drain electrodes of each transistor define a source-drain current path through a channel. The first and second transistors are connected with their source-drain paths in series with each other. The gates of the first and second transistors are connected in common to the series connection between the source-drain current paths. The channel width-to-length ratio, channel mobility, and threshold voltage of the first transistor are substantially equal to the corresponding properties of the second transistor. Any number of transistor pairs may be serially connected together. GRA

N92-13380 Department of the Navy, Washington, DC.
SEA WATER BATTERY POWER CONVERTER Patent
Russell E. Hammond, inventor (to Navy) and John L. Henry, inventor (to Navy) 9 Apr. 1991 10 p Filed 4 Sep. 1990
(AD-D014992; US-Patent-5,006,972; US-Patent-Appl-SN-579201; US-Patent-Class-363-24) Avail: US Patent and Trademark Office CSCL 10/2

The invention converts the voltage output of a DC source to a higher voltage. A germanium transistor start-up circuit receives a DC supply voltage input and includes an astable multivibrator which produces a square wave voltage output that is transformed to a substantially DC steady-state voltage output by a transformer and a capacitor. This elevated voltage is provided to an oscillator circuit which provides two square wave outputs. Each output is provided to an array of invertors operably coupled to an array of field effect transistors. The transistors are operably coupled to a power transformer. The square wave outputs of the power transformer are full wave rectified to provide a DC output having a higher voltage than the system input voltage. The power transformer also provides another full wave rectified voltage which disables the start-up circuit to eliminate parasitic energy losses attributable to its continued oscillation. Author (GRA)

N92-13381 Department of the Navy, Washington, DC.
TRANSMISSION COUPLER ANTENNA Patent

Robert S. Abramo, inventor (to Navy) 7 May 1991 9 p Filed 19 Jan. 1990
(AD-D014993; US-Patent-5,014,068; US-Patent-Appl-SN-467833; US-Patent-Class-343-710) Avail: US Patent and Trademark Office CSCL 09/1

A broad band HF communications antenna for surface ships has an increased survivability over the currently used twin fan antennas. Capacitively coupling a long, flat conductive strap to existing ship structures helps achieve broadband performance. Integral end sections of the long, flat conductive strap are bent at each end and a dielectric layer with a low dielectric constant is provided along the length of each end section. The end sections and dielectric layers provide the areas needed for capacitive coupling to a mast and stack or other parts of the ship's superstructure thereby creating a survivable and broadband HF communications antenna design. GRA

N92-13382# Thermacore, Inc., Lancaster, PA.
INTERCHANGEABLE VARIABLE CONDUCTANCE HEAT PIPES FOR SODIUM-SULFUR BATTERIES Final Report, Aug. 1990 - Jun. 1991
John R. Hartenstine Aug. 1991 47 p
(Contract F33615-90-C-2073)
(AD-A241300; WL-TR-91-2071) Avail: NTIS HC/MF A03 CSCL 20/13

Sodium-sulfur batteries can provide electrical power to satellite instrumentation operating in geosynchronous-earth-orbit (GEO) and low-earth-orbit (LEO) conditions. While on orbit, the sodium-sulfur battery requires thermal management as the battery is cycled between discharge in solar eclipse and recharge in sunlight. As the battery discharges in solar eclipse waste heat is generated and the battery requires cooling. During recharge in sunlight the battery temperature needs to be maintained above 320 C. In this Phase 1 program, Thermacore developed and demonstrated a dual titanium/cesium heat pipe to provide passive, lightweight management of the battery during orbital cycling. The dual heat pipe concept uses both constant and variable conductance heat pipes. Constant conductance heat pipes are inserted between sodium-sulfur cells. The cells radiate to the constant conductance heat pipes and this energy is transferred to a variable conductance heat pipe and radiated to deep space. GRA

N92-13383# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
FUNDAMENTALS OF ADAPTIVE NOISE CANCELING Technical Report, 1988 - 1991
Stuart D. Albert Jun. 1991 74 p
(DA Proj. 1L1-62705-AH-94)
(AD-A241407; SLCET-TR-91-12) Avail: NTIS HC/MF A04 CSCL 12/9

The theory underlying a possible solution, via adaptive noise canceling, to the cosite interference problem encountered by co-located frequency hopping radios is presented. It is also shown how and why adaptive noise canceling can be used, via an adaptive line enhancer (ALE), to separate narrow band deterministic and wide band random signals. Analysis of both an adaptive noise canceler with a single input and an adaptive line enhancer are described in terms of the Wiener or optimal weights of a surface acoustic wave (SAW) programmable transversal filter (PTF) contained within these circuits. In an effort to explain how an adaptive noise canceler with a single input and an ALE actually work, the functional relationship, between the optimal PTF weight values (and hence the PTF frequency response) and the interfering and intended signals is developed in much more detail than is found in textbooks or review articles. Three different adaptive algorithms (Least Mean Square, Differential Steepest Descent, and Linear Random Search) for use with these adaptive filters are also described. A SAW device implementation of a PTF that could be used in building an adaptive noise canceler with single input or an ALE is described. GRA

N92-13384# Lehigh Univ., Bethlehem, PA.
LARGE SIGNAL CHARACTERIZATION AND MODELING OF HETEROJUNCTION BIPOLAR TRANSISTORS Annual Technical Report, 1 Jun. 1990 - 31 May 1991
D. S. Whitefield, C. J. Wei, and J. C. Hwang 30 Jun. 1991 27 p
(AF Proj. 2305; AF Proj. 2306)
(AD-A241461; AFOSR-91-0759TR) Avail: NTIS HC/MF A03 CSCL 09/1

Heterojunction bipolar transistors have been characterized up to 40GHz. In addition to direct current-voltage and high frequency small signal measurements, power and harmonic characterization has been performed. The measurement results were fitted to a ten-element equivalent circuit model in which only three elements were allowed to vary with bias. This bias dependent model is accurate to within 2 percent over the entire bias range and is the first step toward a true large-signal model. The power and harmonic characteristics of the heterojunction bipolar transistor can also be accurately modeled with increasing number of both bias-dependent and fixed elements. Pulsed DC and thermal measurements have also been accomplished to determine the junction temperature and understand its effects on device characteristics.
Author (GRA)

N92-13385# California Univ., Los Angeles. Dept. of Electrical Engineering.
HIGH TEMPERATURE SUPERCONDUCTING PLANAR CIRCUIT STRUCTURE FOR HIGH FREQUENCY APPLICATIONS Annual Report, 1 Jun. - Sep. 1991
Tatsuo Itoh 2 Oct. 1991 3 p
(Contract N00014-91-J-1651)
(AD-A241537) Avail: NTIS HC/MF A01 CSCL 09/1

It is known that the surface resistivity and the depth of penetration of high Tc superconductor may be dependent on the current density or the surface magnetic field. If a printed transmission line such as a microstrip line is made of these materials, the current distribution in the cross section of the strip can affect the local resistivity. This in turn modifies the current distribution. Hence, this is a nonlinear problem. A modified spectral domain method in combination with an iteration process was developed which can analyze the propagation characteristics of the superconducting planar transmission lines. The first step is to modify the spectral domain method in such a way that the position dependent surface resistance is included in the formulation. Next, in order to invoke the standard spectral domain format, the current distribution is expressed in terms of Fourier transforms of the subsectional basis functions. For an assumed current distribution, an iteration process is initiated with an assumption that the surface resistance is constant. After the current distribution is obtained, the surface resistance is readjusted and the process continues until convergence is reached. Author (GRA)

N92-13386# Alphatech, Inc., Burlington, MA.
ANALYSIS AND DEMONSTRATION OF DIAGNOSTIC PERFORMANCE IN MODERN ELECTRONIC SYSTEMS Final Report, Sep. 1988 - May 1990
Jerold L. Weiss, James C. Deckert, and Kevin B. Kelly Aug. 1991 204 p
(Contract F30602-88-C-0068)
(AD-A241621; TR-494; RL-TR-91-180) Avail: NTIS HC/MF A10 CSCL 09/1

This report presents methods and procedures for validation and demonstration of diagnostic system performance for use as part of the Government's acceptance test procedures for electronic systems having contractual diagnostic requirements. These methods provide for examining the adequacy of the diagnostics architecture, establishing bounds on fraction of faults detected (FFD) and fraction of faults isolated (FFI) (the only two figures of merit considered here), and choosing faults to be inserted in the demonstration, but fall short of confirming exact values for FFD and FFI. The current state-of-the-art does not support an exact determination of FFD and FFI for new equipment, especially that containing higher density VLSI and VHSIC electronic devices,

because of the inability to determine the failure rates for the various failure modes, and the difficulty in inserting a truly random sample of faults. GRA

N92-13387# Argonne National Lab., IL.
DYNAMIC-PERFORMANCE MEASUREMENTS OF BATTERY CELLS FOR ELECTRIC VEHICLE AND OTHER APPLICATIONS
L. Redey 1991 9 p Presented at the 180th Meeting of the Electrochemical Society, Phoenix, AZ, 13-18 Oct. 1991
(Contract W-31-109-eng-38)
(DE91-018644; ANL/CP-73233; CONF-911047-7) Avail: NTIS HC/MF A02

Described is a method that has been used to measure dynamic performance of research cells and project performance (Wh/kg and W/kg) for full-size batteries of various designs when discharged in dynamic load profiles, such as the Simplified Federal Urban Driving Schedule (SFUDS). Discharged energy, mWh/cm(exp 2), and power, W/cm(exp 2) of research cells are measured under one-dimensional current distribution by powerdynamic or galvanodynamic discharge techniques. Static discharge and dynamic discharge produce significant differences in cell performance. Hence, the dynamic-performance measuring methods should be extremely useful, even at the early stage of battery research and development, when systems intended for dynamic application are being evaluated. DOE

N92-13388# International Atomic Energy Agency, Vienna (Austria).
SUPERCONDUCTING MATERIALS AND MAGNETS
Apr. 1991 217 p Presented at the IAEA Specialists Meeting on Superconducting Materials and Magnets, Tokyo, Japan, 4-6 Sep. 1989
(DE91-634464; IAEA-TECDOC-594; CONF-8909184) Avail: NTIS HC/MF A10

The Technical Committee Meeting on Superconducting Materials and Magnets was convened by the IAEA and held by invitation of the Japanese government on September 4-6, 1989 in Tokyo. The meeting was hosted by the National Research Institute for Metals. Topics of the conference related to superconducting magnets and technology with particular application to fusion and the superconducting supercollider. Technology using both high and low-temperature superconductors was discussed. This document is a compendium of the papers presented at the meeting. DOE

N92-13389# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
ELECTRONIC STRUCTURE OF BISMUTH IN HIGH-TEMPERATURE SUPERCONDUCTOR Bi(1.6)Pb(0.4)Sr2 Ca(2.5)Cu(3.5)O(SIGMA)
I. M. Band, A. I. Egorovm, and G. I. Karazhanova 1990 8 p In RUSSIAN; ENGLISH summary
(DE91-636323; LIYaF-1623) Avail: NTIS HC/MF A02

The shifts of K(sub (alpha)1) X-ray of bismuth in the high tensile strength (HTS) ceramic Bi(1.6) Pb(0.4)Sr2Ca(2.5)O(sub sigma) and Bi2O3 are measured experimentally. It is shown that bismuth is threevalent in the HTS-ceramic. From comparison of the experimental values of shifts with theoretical values calculated within the framework of different modifications of Hartree-Fock method the effective charge at the bismuth atoms in these compounds is determined: q(Bi2O3 equals 1.5+2.0, q(Bi(1.6)Pb(0.4)Sr2Ca(2.5)Cu(3.5) O(sub (sigma)) equals 1.6+2.1. It was suggested, That the Bi significant covalence degree in HTS-ceramic may be a cause of noticeable contribution of the Bi 6p-states in the density of states at Fermi-level. DOE

N92-13390# Los Alamos National Lab., NM.
HIGH-VOLTAGE VIRTUAL-CATHODE MICROWAVE SIMULATIONS
L. E. Thode and C. M. Snell 1991 29 p Presented at the International School of Plasma Physics High Power Microwave Generation and Applications, Varenna (Italy), 9-17 Sep. 1991
(Contract W-7405-eng-36)
(DE92-000317; LA-UR-91-2834; CONF-9109279-1) Avail: NTIS HC/MF A03

In contrast to a conventional microwave tube, a virtual-cathode device operates above the space-charge limit where the depth of the space-charge potential is sufficiently large to cause electron reflection. The region associated with electron reflection is referred to as a virtual cathode. Microwaves can be generated through oscillations in the position of the virtual cathode and by reflexing electrons trapped in the potential well formed between the real and virtual cathodes. A virtual-cathode device based on the first mechanism is a vircator while one based on latter mechanism is a reflex diode. A large number of low-voltage virtual-cathode microwave configurations have been investigated. Initial simulations of a high-voltage virtual-cathode device using a self-consistent particle-in-cell code indicated reasonable conversion efficiency with no frequency chirping. The nonchirping character of the high-voltage virtual-cathode device lead to the interesting possibility of locking four very-high-power microwave devices together using the four transmission lines available at Aurora. Subsequently, in support of two high-voltage experiments, simulations were used to investigate the effect of field-emission threshold and velvet position on the cathode; anode and cathode shape; anode-cathode gap spacing; output waveguide radius; diode voltage; a cathode-coaxial-cavity resonator; a high-frequency ac-voltage drive; anode foil scattering and energy loss; and ion emission on the microwave frequency and power. DOE

N92-13391# Los Alamos National Lab., NM.
VIRTUAL CATHODE MICROWAVE DEVICES: BASICS
L. E. Thode and C. M. Snell 1991 19 p Presented at the International School of Plasma Physics High Power Microwave Generation and Applications, Varenna (Italy), 9-17 Sep. 1991
(Contract W-7405-eng-36)
(DE92-000318; LA-UR-91-2833; CONF-9109279-2) Avail: NTIS HC/MF A03

Unlike a conventional microwave tube, a virtual-cathode device operates above the space-charge limit where the depth of the space-charge potential can cause electron reflection. The region associated with this electron reflection is referred to as a virtual cathode. Microwaves can be generated through oscillations in the position of the virtual cathode and through the bunching of electrons trapped in a potential well between the real and virtual cathodes. These two mechanisms are competitive. There are three basic classes of virtual cathode devices: (1) reflex triode; (2) reditron and side-shoot vircator; and (3) reflex diode or vircator. The reflex diode is the highest power virtual-cathode device. For the reflex diode the energy exchange between the beam and electromagnetic wave occurs in both the axial and radial directions. In some designs the oscillating virtual-cathode frequency exceeds the reflexing-electron frequency while in other designs the reflexing-electron frequency exceeds the oscillating virtual-cathode frequency. For the flex diode, a periodic disruption in magnetic insulation can modulate the high-frequency microwave power. Overall, particle-in-cell simulation predictions and axial reflex diode experiments are in good agreement. Although frequency stability and phase locking of the reflex diode have been demonstrated, little progress has been made in efficiency enhancement. DOE

N92-13850*# Florida Univ., Gainesville. Dept. of Chemical Engineering.
CONVECTION IN VERTICAL BRIDGMAN CONFIGURATIONS
Ranga Narayanan *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 161-162 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09C

N92-13921 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Electrical Research Dept.
SOFTWARE PACKAGE FOR THE PERFORMANCE OF TRANSIENT SIMULATIONS OF A GENERATOR COUPLED WITH THE PUBLIC POWER-SUPPLY SYSTEM: DIANE
P. M. vanOirsouw and M. E. Kwakkel *In its* KEMA Scientific

and Technical Reports, Volume 7, Number 6 Dec. 1989 p 385-390 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

N92-13924 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Electrochemical Research.
FIELD TESTS FOR DETERMINATION OF THE MAGNETISING CHARACTERISTICS OF THREE-PHASE TRANSFORMERS
C. G. A. Koreman *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 409-422 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

N92-13925 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).
[RESEARCH ACTIVITIES AT THE KEMA R AND D FOR 1988] Annual Report
W. Nagel *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 423-459 (For primary document see N92-13917 04-99)
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34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-13392# Sandia National Labs., Albuquerque, NM.
DEVELOPING CONVECTION ABOVE A FINITE HORIZONTAL SURFACE
T. Y. Chu 1989 6 p Presented at the 9th International Heat Transfer Conference, Jerusalem, Israel, 26-31 Aug. 1990
(Contract DE-AC04-76DP-00789)
(DE90-002833; SAND-89-1301; CONF-900803-1) Avail: NTIS HC/MF A02

The investigation of initiation of convection above a suddenly heated horizontal surface of finite extent is of interest to both the engineering and geophysical fields. The apparatus used in the described experiment consisted of an enclosure with a square planform. A heated strip, whose width was equal to one-fourth of the length of a side of the enclosure, was centered on the lower inside surface of the enclosure. The top of the fluid layer was maintained at a constant temperature, and the depth of the layer was equal to the width of the heated strip. The flow field, heater surface temperature, and heat flux distribution were studied. Flow was observed to initiate near the edges of the heated strip as two convection cells. In time, the two cell boundaries merged into a central plume rising above the heated strip. The velocity field was found to be the most sensitive indicator of convection; surface temperature, the least. Despite the finite width of the heated strip and the finite depth of the layer, the initiation of convection appeared to readily conform to Howard's model of conduction layer instability developed for infinite layers. The average Rayleigh number for the critical conduction layer was 1120. DOE

N92-13393# Clarkson Univ., Potsdam, NY. Fluid Mechanics, Heat and Mass Transfer Lab.
THEORETICAL STUDIES ON THE ROLE OF TRANSITION IN DETERMINING FRICTION AND HEAT TRANSFER IN SMOOTH AND ROUGH PASSAGES
N. T. Obot, E. B. Esen, and T. J. Rabas (Argonne National Lab., IL.) Apr. 1990 165 p
(Contract DE-FG02-89CE-90029)
(DE90-009987; DOE/CE-90029/2) Avail: NTIS HC/MF A08

It has been established that transition determines the attainable friction and heat transfer in smooth and rough passages. According to the proposed law of corresponding states for friction, different types of roughness exhibit the same general behavior for friction at the same reduced conditions. This is also true of different types of smooth passages. It has been fully demonstrated that, in rough passages, the marked increases in friction factor are intimately associated with early transition and that, under reduced similarity conditions, the friction factors are considerably lower than those deduced from the familiar f vs. Re plots. For all smooth or rough passages, the simple rule for heat transfer amounts to this: the lower the critical Reynolds number for transition, the greater the value for the average heat transfer coefficient. Consequently, for a given Reynolds number based on the hydraulic diameter, triangular passages can be expected to give heat transfer coefficients that are significantly higher than for circular, rectangular or annular tubes. For smooth and enhanced passages of complex shapes, it appears that heat transfer coefficients can be calculated accurately from the smooth circular tube relations, provided the critical Reynolds number is known. DOE

N92-13394# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
DEVELOPMENT OF ADVANCED HEAT PUMPS, PART 4
Michiyuki Saikawa, Tetsushiro Iwatsubo, and Teruhide Hamamatsu Feb. 1989 28 p In JAPANESE; ENGLISH summary
(DE90-503046; CRIE-W-88021) Avail: NTIS (US Sales Only) HC/MF A03

As part of the development of advanced heat pump systems for air-conditioning and hot water supply, the performance of a prototype system was evaluated. Technologies associated with the systems practical use were investigated, and topics of future interest were examined. The results from the investigation are presented. DOE

N92-13395 Columbia Univ., New York, NY.
DEVELOPMENT AND APPLICATION OF AN IMPROVED SUBGRID MODEL FOR HOMOGENEOUS TURBULENCE Ph.D. Thesis
Jeffrey Robert Chasnov 1990 147 p
Avail: Univ. Microfilms Order No. DA9118541

With recent advances in computer technology, numerical simulations are currently on the leading edge of turbulence research. However, it will not be possible to resolve the entire spectrum of eddies in a high Reynolds number flow, even with the fastest foreseen computers. A more promising approach consists of explicitly simulating only the largest eddies of the flow, while employing an analytical subgrid model to simulate the effects of the smallest eddies. Previous subgrid models used an eddy viscosity to simulate the net subgrid scale energy transfer. Two objections may be raised to the eddy viscosity model: first, physically, the energy transfer from the subgrid scales to the resolved scales is poorly represented, and; second, any physical effects which do not result in an energy transfer are omitted. A subgrid model that addresses these two objections is developed. First, only the energy transfer from the resolved to the subgrid scales is modeled as an eddy viscosity, whereas the energy transfer from the subgrid to the resolved scales is modeled as a stochastic force. Second, a new effect that does not result in an immediate energy transfer is modeled: the random sweeping of the smallest resolved eddies by the largest. Both the eddy viscosity and the stochastic force of the improved subgrid model are computed from an analytical model and from a direct numerical simulation. The simulation is found to validate the analytical model. The subgrid model is then applied to study: (1) the Kolmogorov inertial subrange; (2) the local and non-local energy fluxes across a given wavenumber, and; (3) the spectrum of a passive scalar field in the inertial diffusive subrange. Dissert. Abstr.

N92-13396# National Center for Atmospheric Research, Boulder, CO.
THE ENERGETICS OF STOCHASTIC CONTINUUM EQUATIONS FOR FLUID SYSTEMS

Rex J. Fleming May 1991 57 p
(Grant NSF ATM-88-05967)
(PB91-212498; NCAR/TN-360+STR) Avail: NTIS HC/MF A04 CSCL 20D

The numerical solution of the relevant prognostic equations for fluid systems involves sources of uncertainty in the initial conditions and uncertainty in the external forces applied to a physical system. The purpose of the note is to introduce stochastic continuum equations for fluid systems that express the uncertainty dynamically. These equations, written in analytical form, describe continuous field quantities which dynamically predict the future and its believability. Beginning with the Navier-Stokes equations and expressing uncertainty as continuous field quantities, one avoids the serious shortcomings and computational redundancy of previous methods using discrete amplitudes (gridpoints or orthogonal functions). No assumptions are made concerning the original deterministic equations, which predict the evolution of a single point in phase space. Rather, these are a subset of the stochastic continuum equations, which predict an infinite cloud of points in phase space. The amount of detailed structure in the shape of the cloud depends upon the degree of derivative closure used in the continuum equations. The solution of the stochastic continuum equations offers a tremendous computational improvement over previous fully stochastic dynamic methods. The equations are perfectly suited to the new emerging parallel computer architecture. GRA

N92-13397*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
[WORK PERFORMED ON VELOCITY PROFILES IN A HOT JET BY SIMPLIFIED RELIEF] Final Report, 12 Jun. 1990 - 30 Jun. 1991
Richard B. Miles and Walter R. Lempert 15 Nov. 1991 61 p
(Grant NAG1-1157)
(NASA-CR-187792; NAS 1.26:187792) Avail: NTIS HC/MF A04 CSCL 20D

The Raman Excitation + Laser Induced Electronic Fluorescence (RELIEF) velocity measurement method is based on vibrationally tagging oxygen molecules and observing their displacement after a short period of time. Two papers that discuss the use and implementation of the RELIEF technique are presented in this final report. Additionally, the end of the report contains a listing of the personnel involved and the reference documents used in the production of this final report. For individual titles, see N92-13398 through N92-13399.

N92-13398*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
VELOCITY PROFILES IN A HOT JET BY SIMPLIFIED RELIEF
In its Work Performed on Velocity Profiles in a Hot Jet by Simplified RELIEF 15 Nov. 1991 p 3-20 (For primary document see N92-13397 04-34)
Avail: NTIS HC/MF A04 CSCL 20D

Raman Excitation + Laser Induced Electronic Fluorescence (RELIEF) is a double resonance velocimetry technique in which oxygen molecules are vibrationally excited via stimulated Raman scattering at a specific location within a flow field. After suitable time delay, typically 1-10 microseconds, the displacement of the tagged molecules is determined by laser induced fluorescence imaging. Providing support for the installation of simplified RELIEF flow tagging instrumentation at NASA LaRC was the principal goal of this research. Author

N92-13399*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
THE APPLICATION OF THE RELIEF TECHNIQUE FOR VELOCITY FIELD MEASUREMENTS IN THE ASTF C1 TEST CELL
In its Work Performed on Velocity Profiles in a Hot Jet by Simplified RELIEF 15 Nov. 1991 p 21-60 (For primary document see N92-13397 04-34)
Avail: NTIS HC/MF A04 CSCL 20D

The Aeropropulsion Systems Test Facility (ASTF) C1 Test Cell is to be configured for propulsion tests of National Aerospace Plane (NASP) engines over flight Mach number conditions ranging from 0.5 to 3.8. This facility is capable of continuously generating a 5 ft. x 5 ft. square free air jet flow field at a local Mach number up to 3.32 with a density of between 0.134 and 0.048 amagat and a static temperature of 257 K or less. The potential of the Raman Excitation + Laser Induced Electronic Fluorescence (RELIEF) velocity measurement technique for measuring the three dimensional velocity profile across the exit plane of this jet and the entrance plane to the test engine under these conditions is examined. Velocity measurements must be done to an accuracy of better than 1 percent. Flow direction must be measured to better than 1 deg for inlet performance evaluation. Measurements to these specifications need to be done with a grid spacing of approximately 1/100th of the cross sectional dimension of the free jet exit in a time not greater than 30 seconds. Author

N92-13400*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
EVOLUTION OF HELE SHAW INTERFACE FOR SMALL SURFACE TENSION Final Report
S. Tanveer (Ohio State Univ., Columbus.) Nov. 1991 64 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187593; NAS 1.26:187593; ICASE-91-53) Avail: NTIS HC/MF A04 CSCL 20D

For the time evolution of a Hele-Shaw interface described by a conformal map z(zeta, t) that maps a unit circle (or a semi-circle) in the zeta plane into the viscous fluid flow region in the physical z-plane, results on the motion of singularities outside the unit circle are presented. For zero surface tension, earlier results are extended to show that for any initial condition, each singularity of z(zeta, t) present initially in the absolute value of zeta greater than 1 continually approaches the interfacial boundary of the absolute value of zeta = 1 without any change of form. However, depending on the singularity type, it may or may not impinge the absolute value of zeta = 1 in finite form. Under some assumptions, analytical evidence is given to suggest that the ill-posed problem in the physical domain of the absolute value of zeta less that or = 1 can be imbedded in a well-posed problem in the absolute value of zeta greater than or = 1. A numerical scheme is presented to calculate such solutions. For each initial singularity of certain type, which in the absence of surface tension would have merely moved to a new location zeta sub s(t) at time t from an initial zeta sub s(0), an immediate transformation of the singularity structure for nonzero surface tension, beta, was found; however, for 0 less than beta much less than 1, surface tension effects on this singularity are limited to a small 'inner' neighborhood of zeta sub s(t) when t is much less than 1/beta. Outside the inner-region but for the absolute value of (zeta - zeta sub s(t)) much less than 1, the singular behavior of z sup 0, the zero surface tension solution still persists for z(zeta, t). On the other hand, for each initial zero of z sub zeta, which for surface tension beta = 0 remains a zero of z(sup 0)(sub zeta) at a location zeta sub 0(t) different from zeta sub 0(0), surface tension effects spawns new singularities that move away from zeta sub 0(t) and approach the physical domain of the absolute value of zeta = 1. Author

N92-13401*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HYDROGEN NO-VENT FILL TESTING IN A 1.2 CUBIC FOOT (34 LITER) TANK
Matthew E. Moran, Ted W. Nyland, and Susan L. Driscoll (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) Oct. 1991 43 p
(NASA-TM-105273; E-6596; NAS 1.15:105273) Avail: NTIS HC/MF A03 CSCL 20D

Experimental results of no-vent fill testing with liquid hydrogen in a 1.2 cubic foot (34 liter) stainless steel tank are presented. More than 40 tests were performed with various liquid inlet temperatures, inlet flowrates, initial tank wall temperatures, and liquid injection techniques. Fill levels equal to or exceeding 90 percent by volume were achieved in 40 percent of the tests with

the tank pressure limited to a maximum of 30 psia. Three liquid injection techniques were employed; top spray, upward pipe discharge, and bottom diffuser. Effects of each of the varied parameters on the tank pressure history and final fill level are evaluated. The final fill level is found to be indirectly proportional to the initial wall and inlet liquid temperatures and directly proportional to the inlet liquid flowrate. Furthermore, the top spray is the most efficient no-vent fill method of the three configurations examined. The success of this injection method is primarily due to condensation of the ullage vapor onto the incoming liquid droplets. Ullage condensation counteracts the tank pressure rise resulting from energy exchange between the fluid and the warmer tank walls, and ullage compression. Upward pipe discharge from the tank bottom is the next most efficient method. Fluid circulation induced by this fill configuration tends to diminish thermal stratification in the bulk liquid, thus enhancing condensation at the liquid gas interface. Author

N92-13402*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMAL MODELING WITH SOLID/LIQUID PHASE CHANGE OF THE THERMAL ENERGY STORAGE EXPERIMENT
J. Raymond Lee Skarda Nov. 1991 49 p Original contains color illustrations
(NASA-TM-103770; E-6032; NAS 1.15:103770) Avail: NTIS HC/MF A03; 3 functional color pages CSCL 20D

A thermal model which simulates combined conduction and phase change characteristics of thermal energy storage (TES) materials is presented. Both the model and results are presented for the purpose of benchmarking the conduction and phase change capabilities of recently developed and unvalidated microgravity TES computer programs. Specifically, operation of TES-1 is simulated. A two-dimensional SINDA85 model of the TES experiment in cylindrical coordinates was constructed. The phase change model accounts for latent heat stored in, or released from, a node undergoing melting and freezing. Author

N92-13403# Pennsylvania State Univ., University Park.
THREE-PHASE DYNAMIC DISPLACEMENT MEASUREMENTS OF RELATIVE PERMEABILITY IN POROUS MEDIA USING THREE IMMISCIBLE LIQUIDS M.S. Thesis
Lew W. Thomas, Jr. May 1991 218 p
(AD-A240863) Avail: NTIS HC/MF A10 CSCL 20/4

An experimental investigation is conducted to examine the simultaneous motion of three phases in porous media. Limited research has been done in this area; therefore, the work is exploratory in nature. Experimental apparatus is constructed to enable the flow of three immiscible fluids through a one-dimensional, horizontal glass bead packed core. The main objective of the research is to map the relative permeabilities of the fluids in the interior region of the ternary diagram through a series of dynamic displacement water floods. Fluid relative permeabilities and saturations during the dynamic displacement experiments are calculated from the three-phase extension of the two-phase dynamic displacement theory of Welge's permeability ratios, and Johnson, Bossler and naumann's two-phase method of determining individual relative permeabilities. GRA

N92-13404# Naval Postgraduate School, Monterey, CA.
HEAT TRANSFER, ADIABATIC EFFECTIVENESS AND INJECTANT DISTRIBUTIONS DOWNSTREAM OF SINGLE AND DOUBLE ROWS OF FILM-COOLING HOLES WITH COMPOUND ANGLES M.S. Thesis
David T. Bishop, Jr. Sep. 1990 150 p
(AD-A241095) Avail: NTIS HC/MF A07 CSCL 20/13

Experimental results are presented which describe the development and structure of turbulent boundary layer flow downstream of single and double rows of film-cooling holes with compound angles. The film-cooling holes are inclined at an angle of 30 degrees when projected into the spanwise/normal (Y-Z) planes and at an angle of 35 degrees when projected into the streamwise/normal (X-Y) planes with respect to the test surface. Three configurations are used: (1) one row of film-cooling holes with a blowing ratio of m=0.5, (2) one row of film-cooling holes with a blowing ratio of m=1.0, and (3) two staggered row of film-cooling holes with a blowing ratio of m=0.5. Results indicate that the highest eta values are obtained when two rows of compound angle injection cooling holes are employed with a blowing ratio of m=0.5, and that the lowest eta values results when one row of compound angle injection cooling holes is employed with a blowing ratio of m=1.0. Near film cooling holes and for x/d as high as 87, streamwise mean velocity and total pressure distributions show spanwise periodicity near the wall as a result of the discrete nature of film injection. At x/d=10.2, injectant distributions are non-circular in spanwise normal planes. These distributions spread in lateral and normal directions as the boundary layer convects downstream. GRA

N92-13405# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
CAUSES AND EFFECTS OF CHAOS
Elizabeth Bradley Dec. 1990 46 p
(Contracts N00014-85-K-0124; N00014-86-K-0180)
(AD-A241157; AI-M-1216) Avail: NTIS HC/MF A03 CSCL 20/4

Chaos was first discovered in turbulent fluid flow, considered the unsolved problem in classical physics. Fluid flow turns from smooth (laminar) to turbulent as its velocity increases. The classic explanation for this was that new frequencies appeared, one at a time, in the velocity and density profiles. In the early 1960's, a meteorology professor at MIT named Edward Lorenz simulated the actions of an air mass between warm ground and cool clouds, modeled by a simplified version of the Navier-Stokes equations for fluid flow. Mathematically, the definition of chaotic behavior requires: sensitive dependence upon initial conditions topological transitivity and dense periodic points in the Poincare section of the system's state space. Sensitive dependence is illustrated by Smale's horseshoe, the nonlinear transformation. GRA

N92-13406# Naval Postgraduate School, Monterey, CA.
FLOW MODIFICATION OVER A BACKWARD FACING STEP M.S. Thesis
Marshall L. Narveson Sep. 1990 100 p
(AD-A241351) Avail: NTIS HC/MF A05 CSCL 01/1

The Naval Postgraduate School (NPS) has undertaken a series of studies on ship air wake tailoring, through the use of deflectors, with the goal of reducing the level of turbulence and the size of the separated zones on the helicopter deck. This reduction will result in a larger engage/disengage envelope, which in turn, will increase the percentage of time that the H-46 and other helicopters can safely operate. This study is the second in the series of NPS to attempt to achieve this goal and considers only the feasibility of tailoring a two-dimensional flow over a backward facing step. Nonporous flat and curved deflectors and porous flat deflectors were mounted in various positions near the edge of the step and the flow patterns recorded using both still and video photography. The deflectors were mounted at varying separations from the step and varying angles to the vertical. It was found that the porous deflectors produced the lowest velocities in the region behind the step, and the nonporous produced the greatest changes in the flow pattern. The results were also compared to the results of the first study that used the PHOENICS computational fluid dynamics program. With one exception, the results differed only by the underprediction of the length of the horizontal flow pattern. GRA

N92-13407# Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
A TURBULENCE MODEL FOR RECIRCULATING FLOW Final Report
Robert S. Bernard Sep. 1991 30 p
(AD-A241355; WES/TR/HL-91-14) Avail: NTIS HC/MF A03 CSCL 20/4

A simple adjustment is proposed that improves the predictions of the standard k-epsilon turbulence model in the presence of two-dimensional recirculating flow. An eddy Reynolds number calculated from velocity, vorticity, and eddy viscosity is introduced

as a scaling parameter for reducing the decay term in the governing equation for the turbulence-energy dissipation rate. Using the adjusted k-epsilon model to compute the flow past a backstep (channel expansion), the STEMR finite-difference code gives better predictions for streamlines, velocities, and turbulence energies than it does with the standard k-epsilon model. Computed reattachment lengths compare well with experimental data for channel expansion ratios between 1 and 2. GRA

N92-13408# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
PROCEEDINGS OF THE WORKSHOP ON PROBLEMS OF ROTATING LIQUIDS Final Report
Miles C. Miller and Daniel D. Joseph Jul. 1991 340 p Workshop held in Minneapolis, MN, 22-23 Apr. 1991
(AD-A241378; CRDEC-SP-038) Avail: NTIS HC/MF A15 CSCL 19/10

Status of technology related to rotating fluid dynamics with special emphasis on liquid filled projectiles is reviewed. Sixteen technical papers are presented on the following topics : Analysis and visualization of the flow in a spinning and nutating cylinder; A centrifugal spectrometer; Moment exerted by a viscous liquid in a spinning, coning container; Numerical simulation for non-cylindrical liquid-filled containers; Motion of two immiscible fluids in a spinning and coning cylinder; Direct measurement of liquid effects using a moment balance; Laboratory flight stability evaluation of production M825A1 payload canisters; Theory and experiments for rotating porous media flow; Effects of interior canister wall roughness on liquid despin moments; Instrumented flight tests artillery projectiles with selected liquid-fills. GRA

N92-13409# University of Southern California, Los Angeles. Dept. of Aerospace Engineering.
A NEW TECHNIQUE FOR TEMPERATURE AND SPECIE CONCENTRATION MEASUREMENTS IN UNSEEDED SUPERSONIC AND HYPERSONIC GAS FLOWS Final Report, 2 Feb. 1988 - 1 Feb. 1991
Daniel A. Erwin, Joseph A. Kunc, and E. P. Muntz 9 Aug. 1991 16 p
(Grant AF-AFOSR-0119-88; AF Proj. 2307)
(AD-A241536; AFOSR-91-0808TR) Avail: NTIS HC/MF A03 CSCL 20/4

The goal was to develop an experimental diagnostic technique suitable for gas flows of densities intermediate between atmospheric and rarefied. A laser assisted electron beam fluorescense technique which we call electron photon fluorescense was developed. Theoretical work was done to predict the time dependence of the excitation/deexcitation processes. As described in the original proposal, our goal in this work was the attainment of an experimental diagnostic technique suitable for gas flows of densities intermediate between atmospheric and rarefied. Measurements in such intermediate density flows, typical of hypersonic flight at altitudes above about 50 km, present difficulties in that traditional wind-tunnel techniques (shadow and schlieren, as well as laser based scattering techniques) provide insufficient signal. Moreover, the resonant scattering techniques may require an absorptive species as a tracer to be seeded into the flow, a requirement inconsistent with the realities of existing large facilities. On the other hand, the densities are not enough for continuous electron-beam fluorescence (EBF) to be used due to beam spreading and collisional quenching. GRA

N92-13410# David Taylor Research Center, Bethesda, MD. Propulsion and Auxiliary Systems Dept.
UNSTEADY FLOWS IN ROTOR-STATOR CASCADES Research and Development Report
Yu-Tai Lee, Thomas W. Bein, Jin Z. Feng, and Charles L. Merkle Mar. 1991 43 p
(AD-A241593; DTRC/PAS-91/7) Avail: NTIS HC/MF A03 CSCL 20/4

A time-accurate potential-flow calculation method has been developed for unsteady incompressible flows through two-dimensional multi-blade-row linear cascades. The method represents the boundary surfaces by distributing piecewise linear-vortex and constant-source singularities on discrete panels. A local coordinate is assigned to each independently moving object. Blade-shed vorticity is traced at each time step. The unsteady Kutta condition applied is nonlinear and requires zero blade trailing-edge loading at each time. Its influence on the solutions depends on the blade trailing-edge shapes. Steady biplane and cascade solutions are presented and compared to exact solutions and experimental data. Unsteady solutions are validated with the Wagner function for an airfoil moving impulsively from rest and the Theodorsen function for an oscillating airfoil. The shed vortex motion and its interaction with blades are calculated and compared to an analytic solution. For multi-blade-row cascade, the potential effect between blade rows is predicted using steady and quasi unsteady calculations. The accuracy of the predictions is demonstrated using experimental results for a one-stage turbine stator-rotor. GRA

N92-13411# David Taylor Research Center, Bethesda, MD. Propulsion and Auxiliary Systems Dept.
MOVING-FRAME TIME DEPENDENCE IN A DIFFERENTIAL TURBOMACHINERY EQUATION WITH VISCOUS CORRECTION Research and Development Report
Herman B. Urbach Aug. 1991 29 p
(AD-A241594; DTRC/PAS-91/29) Avail: NTIS HC/MF A03 CSCL 12/2

A Differential Turbomachinery Equation describing the energy transfer between a fluid and any body moving in that fluid was derived. The derivation is based upon the Coriolis form of the Navier-Stokes Equations. A differential equation for the total relative rothalpy is also obtained. Both equalities contain a rigorous correction. Both may be evaluated in the absolute and moving frame. On integration of the differential equations, a form of the Euler Turbomachinery Equation with viscous correction is derived. The resultant form contains two distinct work rate terms for the axial and radial components of the flow. The fact that integration yields a result which approximates the classic Euler Turbomachinery Equation constitutes confirmation of the derivation. An application of the equation to an ideal infinite linear cylinder with bound vorticity was developed, yielding the expected known results. GRA

N92-13412# Naval Postgraduate School, Monterey, CA.
STUDY OF THE EFFECTS OF CENTRIFUGAL INSTABILITIES ON FLOW IN A 40 TO 1 ASPECT RATIO RECTANGULAR CURVED CHANNEL, FOR DEAN NUMBERS FROM 35 TO FULLY TURBULENT CONDITIONS M.S. Thesis
William A. Fields Dec. 1990 191 p
(AD-A241742) Avail: NTIS HC/MF A09 CSCL 20/4

The development and structure of Dean vortices in a high aspect ratio curved channel were measured and studied for Dean numbers from 35 to fully turbulent conditions. Mean vorticity components were determined from measurements of the three components of mean velocity, which were measured using a miniature five-hole pressure probe. Streamwise, radial, and spanwise vorticity components measured 120 deg from the start of curvature, show evidence of Dean vortices in the time-averaged flow field. Peak streamwise and peak spanwise vorticity, as well as streamwise circulation, generally increase as the Dean number increases from 60 to 240. Peak radial vorticity increases as Dean numbers vary from 60 to about 160. Spectra obtained from hot-wire probes show evidence of different frequency events, including twisting and undulation. Twisting is apparent for Dean numbers of 135 to 160 while undulation is observed at lower Dean numbers. Flow visualization results illustrate a variety of time dependent events in the channel. GRA

N92-13413# New York Univ., New York.
NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS FOR GAS AND ELASTICITY Final Report, 1 Jan. 1989 - 31 Dec. 1990
Tai-Ping Liu 31 Dec. 1990 3 p
(Grant AF-AFOSR-0203-89; AF Proj. 2304)
(AD-A241791; AFOSR-91-0884TR) Avail: NTIS HC/MF A01 CSCL 20/4

We obtain a striking new phenomenon that a perturbation of a viscous overcompressive shock wave produces another wave with same given end states without other time-asymptoti state. This is markedly distinct from the vicous shock waves in gas flow. The author subsequently studied the overcompressive shocks in a MHD and elasticity model. Such a wave is called intermediate shock wave, whose admissibility has been controversial since the 1950's. One of the main research interests of the author in recent years has been the qualitative understanding of viscous conservation laws such as the compressible Navier-Stokes equations. Usual approach uses typical parabolic techniques such as spectral and energy methods, or maximum principle. These methods are of limited effectiveness because they fail to detect the hyperbolic mature of underlying inviscid models. A new approach is introduced to incorporate the nonlinear coupling of waves pertaining to different characteristics families, such as nonlinear acoustic wave and entropy waves in gas flow. GRA

N92-13414# Minnesota Univ., Minneapolis. School of Mathematics.
INERTIAL MANIFOLDS FOR NAVIER-STOKES EQUATIONS AND RELATED DYNAMICAL SYSTEMS Final Annual Report, 1 Aug. 1987 - 31 May 1991
Mitchell Luskin and George R. Sell 31 May 1991 22 p
(Contract F49620-87-C-0095)
(AD-A241805; AFOSR-91-0889TR) Avail: NTIS HC/MF A03
CSCL 12/2

The support from AFPSR/DARPA received over this four year period has enabled the research team at the University of Minnesota to make substantial strides in their efforts to better understand the long-time dynamics of the Navier-Stokes equations and related dynamical systems. The accomplishments on this project have had the effect of giving the University of Minnesota the reputation of being one of the leading research centers in the world in the area of the dynamics of the Navier-Stokes equations. Two major scientific breakthroughs were recently made in the study of the dynamics of the Navier-Stokes equations by scientists working on this project. GRA

N92-13415# Oak Ridge National Lab., TN.
THERMAL PERFORMANCE ANALYSIS FOR HEAT EXCHANGERS HAVING A VARIABLE OVERALL HEAT TRANSFER COEFFICIENT
J. C. Conklin and E. Granryd (Royal Inst. of Tech., Stockholm, Sweden) 1991 7 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE91-015633; CONF-911213-4) Avail: NTIS HC/MF A02

The classic, conventional analysis for the thermal performance of heat exchangers is based on three assumptions: constant fluid flow rate, constant specific heat fluids, and constant overall heat transfer coefficient. Our analysis describes a general approach for analyzing the thermal performance of heat exchangers in which the overall heat transfer coefficient varies as a function of enthalpy, with the other two basic assumptions of constant mass flow rates and constant specific heats unchanged. Many heat exchangers have an overall heat transfer coefficient that is not constant. The conventional heat exchanger thermal performance analysis is correct as long as a true, area-weighted mean value is used. In many applications, however, fluids undergo a change in phase, and the heat transfer coefficient is a function of the local quality or enthalpy; hence, the true, area-weighted, mean heat transfer coefficient will be a function of the heat flux distribution. Examples are presented that illustrate the variation in overall heat transfer coefficient for an evaporation process. We present a general method for computing a true, area-weighted mean overall heat transfer coefficient that permits use of a local overall heat transfer coefficient that is an arbitrary function of enthalpy. This method allows a simple yet accurate analysis of the effects of a variable overall heat transfer coefficient to be made without the use of a large mainframe computer. We then investigate: (1) linear variation of local overall heat transfer coefficient with respect to enthalpy; and (2) two heat transfer correlations applicable to flow-boiling inside a tube. DOE

N92-13416# International Centre for Theoretical Physics, Trieste (Italy).
A METHOD FOR THE APPROXIMATE SOLUTIONS OF THE UNSTEADY BOUNDARY LAYER EQUATIONS
Md. AbdusSattar Dec. 1990 12 p
(DE91-633963; IC-90/423) Avail: NTIS HC/MF A03

The approximate integral method proposed by Bianchini et al. to solve the unsteady boundary layer equations is considered here with a simple modification to the scale function for the similarity variable. This is done by introducing a time dependent length scale. The closed form solutions, thus obtained, give satisfactory results for the velocity profile and the skin friction to a limiting case in comparison with the results of the past investigators. DOE

N92-13417# International Centre for Theoretical Physics, Trieste (Italy).
LAX-PHILLIPS SCATTERING THEORY WITH PERTURBATIONS OF THE TYPE: V(x)=PHI(x)/ABSOLUTE VALUE OF x(SUP BETA)), WHERE BETA = 2 - n/s, PHI IS AN ELEMENT OF L(SUP s)(R(SUP n)), s IS GREATER THAN 2 AND s IS GREATER THAN OR EQUAL TO n/2
F. Brambila-Paz and Minh Duc Duong Dec. 1990 18 p
(DE91-633986; IC-90/424) Avail: NTIS HC/MF A03

A scattering theory for the wave equation with compactly supported perturbations was developed by Lax-Phillips in 1967. Using Enss approach, Phillips developed a Lax-Phillips scattering theory with short range perturbations of the type: V(x) equals o (1)/ x (exp (beta)), (beta) greater than 2. In this paper we develop a scattering theory for more general perturbations, i.e., for V(x) equals (phi(x) / x (exp (beta)), where (beta) equals 2-(n)/s, phi is an element of L(exp s)(R(sup n)), s greater than 2 and s greater than or equal to (n)/2. DOE

N92-13840*# Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Aeronautical Engineering.
PROPER ORTHOGONAL DECOMPOSITION BASED TURBULENCE MODELING
Mark N. Glauser *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 103-110 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20D

N92-13867*# Texas Univ., Austin. Dept. of Mechanical Engineering.
THE EFFECT OF A TYPE 3 AND TYPE 4 SHOCK/SHOCK INTERACTION ON HEAT TRANSFER IN THE STAGNATION REGION
Dennis Wilson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 232-235 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N92-13418*# Alabama Univ., Huntsville.
GENERAL PURPOSE INTELLIGENT SENSOR INTERFACE Final Report

J. W. McKee Mar. 1990 83 p
(Contract NAS8-36955)
(NASA-CR-184223; NAS 1.26:184223; JRC-RR-90-08) Avail: NTIS HC/MF A05 CSCL 14B

The long range goal is to develop an intelligent sensor system that will simplify the design and development of expert systems that use sensors of physical phenomena as a source of input data. This phase of the research concentrated on the integration of image processing sensors with expert system environments. The anticipated result of this research is the ability to design systems in which the user will not need to be an expert in such areas as image processing algorithms, local area networks, image processor hardware selection or interfacing, or television cameras selection. The user will be able to access data from video sensors through standard expert system statements without any need to know about the sensor hardware or software. Author

N92-13419# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
METAL THERMOCOUPLE CORRECTION METHODOLOGY AND EVALUATION (ECS-2C/ECS-2B TEST SERIES)
J. L. Anderson, T. K. Larson, and K. G. Condie Jun. 1991 110 p
(Contract DE-AC07-76ID-01570)
(DE91-018749; EGG-EAST-9352) Avail: NTIS HC/MF A06

The metal thermocouple correction methodology and evaluation experiments were designed and performed to investigate downflow dryout in a heated ribbed vertical annulus. Subsequent experiments were performed in the same facility to investigate convective heat transfer under air/water downflow conditions. Under these conditions (greater than 40 K) azimuthal temperature variations were observed in the skin temperature measured using Type K thermocouples. The physical mechanisms causing the azimuthal variations in the thermocouples have not been identified. A methodology has been developed and evaluated for removing these effects. An uncertainty analysis has been performed to estimate the uncertainties resulting from application of the methodology. However, it is recommended that this methodology not be applied to the individual thermocouples unless a viable physical mechanism is identified to explain the observed thermocouple responses. DOE

N92-13420# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.
A SYSTEM FOR THE DIGITAL IMAGE ANALYSIS OF SPRAY SAMPLES
B. Panneton (Agriculture Canada, Ottawa, Ontario) and A. M. Drummond Nov. 1990 44 p
(NRC-32134; IAR-AN-68; CTN-91-60262) Copyright Avail: NTIS HC/MF A03

This work describes an image analysis system based on an electronic digitizing camera developed to assist with the measurement of deposition patterns of liquids such as pesticides released as droplets or aerosols from aerial sprayers. In the course of these experiments, Kromekote (TM) cards were used to collect spray samples at ground level. The analysis of these samples involves the measurement of the area and circumference of the stains from which data on the drop size and deposit density can be derived. The stains typically measured from 100 to 2500 microns in diameter. The implementation and the development of both the hardware and the software are discussed as well as system performance. The system is capable of digitizing a sample into 1504 by 3008 pixels using 256 grey levels. The resolution is 10 microns at the image plane and droplet diameters can be estimated with a most likely error of 3.5 microns. Although the system was developed to analyze spray samples, the system can be used to analyze any types of image so long as contrast between the background and the features of interest is sufficiently high. CISTI

N92-13421# Naval Research Lab., Washington, DC.
MULTIMODE SIMULATION OF HIGH FREQUENCY GYROTRONS Interim Report
S. H. Gold and A. W. Fliflet 5 Sep. 1991 31 p
(AD-A240903; NRL-MR-6872) Avail: NTIS HC/MF A03 CSCL 09/1

This paper presents a simulation study of mode competition in highly overmoded gyrotron cavities. The parameters of the study have been selected to correspond to the approximate design parameters of a 280 GHz, 1 MW gyrotron at the Massachusetts Institute of Technology (MIT). The MIT gyrotron is designed to run in the TE+42,7 mode, using a 50 A, 84 keV electron beam, with a normalized beam radius of 0.6, and a beam alpha of 1.6. This study addresses (1) the problem of achieving gyrotron operation in the design mode, and at a value of magnetic detuning sufficient to achieve high efficiency operation, and (2) the mode purity of the final state. GRA

N92-13422 Department of the Navy, Washington, DC.
MULTIPLE SENSOR MAGNETOMETER WITH TEMPORAL NOISE REDUCTION AND CONTROLLABLE SPATIAL RESPONSE ON A MOVING PLATFORM Patent
George W. Byram, inventor (to Navy) 9 Jul. 1991 12 p Filed 21 Jun. 1982
(AD-D015003; US-Patent-5,030,913; US-Patent-Appl-SN-390421; US-Patent-Class-324-244) Avail: US Patent and Trademark Office CSCL 17/5

A mobile magnetometry processing system which scans an area in order to measure the magnetic field strength over the area is described. The system is comprised of the following: a plurality of N sensors for sensing the magnetic field of the area being scanned, each sensor generating an output signal, for example, a voltage, which is a function of the magnetic field it scans, the sensor being aligned in the general direction of the motion of the system; a plurality of N sets of means for weighting, for receiving and weighting the N signals from the means for sensing, each of the N sets comprising M weighting means; a plurality of M summers, each have N inputs, one from each of the N sets of means for weighting, for summing its N input weighted signals; and a plurality of M filters each having an input which is connected to the output of a summer, for delaying the exit of an input signal by an amount of time equal to the time required for a sensor to advance the distance to the nearest adjacent sensor, the filtering process comprising a convolution. GRA

N92-13423# Argonne National Lab., IL.
SOFT X-RAY UNDULATOR Final Report, Mar. 1990 - Sep. 1991
Samuel D. Bader 24 Sep. 1991 51 p
(Contract N00014-87-F-0022)
(AD-A241481) Avail: NTIS HC/MF A04 CSCL 20/7

A soft x-ray undulator has been based at the vacuum ultraviolet storage ring at the National Synchrotron Light Source. The undulator is being used as a radiation source by a multi-institutional research team to perform the first spin polarized photoemission experiments in the United States to study novel ultra-thin magnetic films and surfaces. GRA

N92-13424# Stanford Univ., CA. Physics Lab.
TUNNELING ACOUSTIC MICROSCOPY Technical Report, 1 Apr 1990 - 31 Mar. 1991
C. F. Quate and B. T. Khuri-Yakub Sep. 1991 15 p
(Contract N00014-90-J-1635)
(AD-A241547; SU-GL-4863) Avail: NTIS HC/MF A03 CSCL 09/1

We have integrated silicon micromachining techniques with piezoelectric thin film deposition to make a near-field acoustic microscope. A piezoelectric zinc oxide (ZnO) transducer is deposited on a substrate of 7740 glass. A sharp tip is formed in a silicon wafer which is anodically bonded to the glass substrate. A sample is attached to substrate of glass with a receiving ZnO transducer. The transducer on the tip excites an ultrasonic beam which passes from the tip to the sample and is detected by the receiving transducer. A feedback signal is generated to keep the transmitted amplitude constant as a sample is raster scanned. The feedback signal is applied to a tube scanner and is also

used to modulate the intensity of a display monitor. We find that the instrument has a vertical height sensitivity of about 20 Angstroms and a lateral resolution of better than 800 Angstroms. GRA

N92-13425# Sandia National Labs., Albuquerque, NM.
ACCELEROMETER AND STRAIN GAGE EVALUATION
D. J. Ammerman, M. M. Madsen, W. L. Uncapher, D. R. Stenberg, and D. R. Bronowski 19 Jun. 1991 216 p
(Contract DE-AC04-76DP-00789)
(DE92-000191; SAND-91-0077; TTC-1053) Avail: NTIS HC/MF A10

This document describes the method developed by Sandia National Laboratories (SNL) to evaluate transducer used in the design certification testing of nuclear material shipping packages. This testing project was performed by SNL for the Office of Civilian Radioactive Waste Management (OCRWM). This evaluation is based on the results of tests conducted to measure ruggedness, failure frequency, repeatability, and manufacturers' calibration data under both field and laboratory conditions. The results of these tests are provided and discussed. The transducer were selected for testing by surveying cask contractors and testing facilities. Important insights relating to operational characteristics of accelerometer types were gained during field testing. DOE

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N92-13426# Lawrence Livermore National Lab., CA.
START-EFFECT MEASUREMENT OF HIGH FEL (FREE-ELECTRON LASER) ELECTRIC FIELDS IN MTX (MICROWAVE TOKAMAK EXPERIMENT) BY LASER-AIDED PARTICLE-PROBE SPECTROSCOPY
T. Oda, K. Takiyama, K. Odajima, K. Ohasa, M. Shiho, K. Mizuno (California Univ., Davis.), and J. H. Foote 10 May 1990 12 p
Presented at the 8th Topical Conference on High-Temperature Plasma Diagnostics, Hyannis, MA, 6-10 May 1990
(Contract W-7405-eng-48)
(DE90-013474; UCRL-102939-Rev-1; CONF-900557-5) Avail: NTIS HC/MF A03

We are constructing a diagnostic system to measure the electric field (greater than 100 kV/cm) of a free-electron laser (FEL) beam when injected into the plasma of the Microwave Tokamak Experiment (MTX). The apparatus allows a crossed-beam measurement, with 2-cm spatial resolution in the plasma, involving the FEL beam (with 140-GHz, approximately 1-GW ECH pulses), a neutral-helium beam, and a dye-laser beam. After the laser beam pumps metastable helium atoms to higher excited states, their decay light is detected by an efficient optical system. Because of the Stark effect arising from the FEL electric field (E), a forbidden transition can be strongly induced. The intensity of emitted light resulting from the forbidden transition is proportional to E(exp 2). Because photon counting rates are estimated to be low, extra effort is made to minimize background and noise levels. It is possible that the lower E of an MTX gyrotron-produced ECH beam with its longer-duration pulses can also be measured using this method. Other applications of the apparatus described here may include measurements of ion temperature (using charge-exchange recombination), edge-density fluctuations, and core impurity concentrations. DOE

N92-13427 Texas Univ., Arlington.
CHARACTERIZATION AND MODELLING OF DISTRIBUTED FEEDBACK DIODE LASERS Ph.D. Thesis
Bradley Michael Kanack 1990 211 p
Avail: Univ. Microfilms Order No. DA9121149

The temperature dependence was determined of the rate equation parameters and engineering models were developed based upon measurements, for a GaInAsP double heterojunction distributed feedback laser. In addition, a uniform test methodology for the investigation of laser diodes was developed. The theory and models were based on a rate equation formalism which included a nonlinear gain compression term and the important recombination processes. Direct measurement of operational characteristics at different temperatures was used to determine all the rate equation parameters and their temperature dependence. A novel DC characterization technique was established to aid in the development of the laser model. Using a nonlinear optimization algorithm, the ideal diode equation parameters were found for measured voltage current data. Using the rate equations, a small circuit model was derived. By direct optimization of the rate equation parameters using the circuit model, in combination with the parameters determined from the DC measurements, it was found that the remaining unknown parameters were uniquely defined. Finally, a large signal model was derived based on the rate equations and example simulations were performed for a laser diode to find the effect of temperature on the optical response. Dissert. Abstr.

N92-13428# Washington State Univ., Pullman.
CONDITIONS FOR SUB-POISSONIAN PHOTON STATISTICS IN PHASE-CONJUGATED RESONANCE FLUORESCENCE
Henk F. Arnoldus and Thomas F. George Sep. 1991 24 p
(Contract N00014-90-J-1193)
(AD-A240877; WSU/DC/91/TR-63) Avail: NTIS HC/MF A03 CSCL 20/5

Photon correlations and statistics of phase-conjugated resonance fluorescence of a two-state atom is considered. The Q factor, as a function of the incident laser power, the deturning, the laser linewidth and the phase-conjugate reflectivity, has been calculated. It is shown that for small and large reflectivity the statistics is predominantly sub-poissonian. For unit reflectivity the statistics appear to be exactly poissonian (Q equals O) for all values of the optical parameters. GRA

N92-13429# Naval Postgraduate School, Monterey, CA.
MAGNETIC FIELDS AND ELECTRON TRAJECTORIES AT THE END OF A HELICAL UNDULATOR M.S. Thesis
Daniel E. Craun Dec. 1990 85 p
(AD-A241700) Avail: NTIS HC/MF A05 CSCL 20/7

An undulator is a periodic magnetic field device that is an integral part of a Free Electron Laser (FEL). The key to FEL performance is the undulator design. This thesis models the undulator magnetic fields by using the Biot-Savart law, a current element integration technique. Applying this technique to different winding schemes for a bifilar helical compact undulator, the field structure is computed for positions outside the entrance to the undulator. These stray fields can have a focus or defocusing effect on the incoming electron beam. This disturbs the critical matching of the electron velocity vectors with the co-propagating laser radiation. The matching of velocity vectors controls the bunching of the electrons. This bunching action controls the gain of the FEL, and thus, the ultimate performance of the entire device. By choosing a better design for the undulator, this unwanted effect is reduced. The field structure found from integration determines the electron trajectories. The best design for the undulator is then determined by the imposed input conditions on the electron beam for entry into the cavity. An additional benefit of this technique is a potential application to finding coil winding tolerances for undulator construction. Author (GRA)

N92-13833*# Florida Univ., Gainesville. Dept. of Aerospace Engineering, Mechanics, and Engineering Science.
CALIBRATION OF A TUNABLE EXCIMER LASER USING THE OPTOGALVANIC EFFECT
John D. Abbitt *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 58-60 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20E

N92-13841*# Christopher Newport Coll., Newport News, VA. Dept. of Physics.
THE ROLE OF TIME AND SPEED IN NASA'S SUNLITE PROGRAM
Joseph C. Hafele *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 111-114 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20E

N92-13870*# California Polytechnic State Univ., San Luis Obispo. Dept. of Electronic Engineering Technology.
ON THE CONTROL ASPECT OF LASER FREQUENCY STABILIZATION
Omar Zia *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 250-253 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-13430# Central Research Inst. of Electric Power Industry, Tokyo (Japan). Energy and Environment Lab.
WATER-COOLING TECHNIQUE OF HIGH TEMPERATURE GAS TURBINE BLADE
Toshio Sakuma May 1989 35 p In JAPANESE; ENGLISH summary
(DE90-503403; CRIE-T-88056) Avail: NTIS (US Sales Only) HC A03

The experimental results of water cooled turbine blades which were performed under non-steady state conditions are described, and the flow resistance is obtained experimentally. The essential results are as follows: (1) temperate fluctuation of blade and cooling water can be restrained using a concentric tube of cooling holes; (2) cooling effectiveness of the blade is nearly constant independent of cooling water flow rate; and (3) friction loss of rotating concentric tube and loss of heat in the region of 180 degree turnover, at rotation, are obtained. DOE

N92-13431*# Alabama Univ., Huntsville.
CHARACTERISTICS AND PERFORMANCE OF THE VARIABLE POLARITY PLASMA ARC WELDING PROCESS USED IN THE SPACE SHUTTLE EXTERNAL TANK Final Report
R. J. Hung, C. C. Lee, and J. W. Liu Jul. 1990 73 p
(Contract NAS8-36955)
(NASA-CR-184226; NAS 1.26:184226) Avail: NTIS HC/MF A04 CSCL 13H

Significant advantages of the Variable Polarity Plasma Arc (VPPA) Welding Process include faster welding, fewer repairs, less joint preparation, reduced weldment distortion, and absence of porosity. Flow profiles and power distribution of argon plasma gas as a working fluid to produce plasma arc jet in the VPPA welding process was analyzed. Major loss of heat transfer for flow through the nozzle is convective heat transfer; for the plasma jet flow between the outlet of the nozzle and workpiece is radiative heat transfer; and for the flow through the keyhole of the workpiece is convective heat transfer. The majority of the power absorbed by the keyhole of the workpiece is used for melting the solid metal workpiece into a molten metallic puddle. The crown and root widths and the crown and root heights can be predicted. An algorithm for promoting automatic control of flow parameters and the dimensions of the final product of the welding specification to be used for the VPPA Welding System operated at MSFC are provided. Author

N92-13432# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
DEVELOPMENT OF GAS TURBINE COMBUSTOR BURNING COAL DERIVED LOW BTU GASEOUS FUELS, PART 4
M. Sato, T. Ninomiya, T. Nakada, T. Abe, Hiroshi Ishikawa, T. Yoshine, M. Yamada, S. Hisa, and H. Hasegawa Oct. 1989 25 p In JAPANESE; ENGLISH summary
(DE90-507871; CRIE-W-89014-Pt-4) Avail: NTIS (US Sales Only) HC/MF A03

This paper describes the development of a gas turbine combustor burning coal-derived low calorific value gaseous fuels. Combustion tests were conducted using a combustor of a 150 MW class gas turbine. Coal derived gaseous fuels contain carbon monoxide and hydrogen as main combustible components, but also contain more than 60 percent of nitrogen, carbon dioxide etc., and their calorific values are approximately one-tenth of natural gas. Rich-lean combustion was very effective for decreasing fuel nitrogen oxides emission in a gas turbine combustor. However, the flame stability must be maintained in a primary combustion zone, and a sub combustor was provided for the flame stability. The combustibility of the tested combustor was excellent. Methane concentration in coal derived gaseous fuels affected on fuel nitrogen oxides formation, and it was clarified that there will be optimum equivalence ratio in a primary combustion zone according with the change of methane concentration. DOE

N92-13433# Sandia National Labs., Albuquerque, NM.
FUSION WELDING OF REFRACTORY METALS
C. V. Robino 1991 10 p Presented at the Fall Meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE91-018397; SAND-91-1843C; CONF-911003-12) Avail: NTIS HC/MF A02

The refractory metals of Groups 5B and 6B and their alloys display a variety of unique physical and mechanical characteristics in addition to their high melting points. In turn, these characteristics make these materials strong candidates for severe service and specialized applications. However, these materials also present a variety of challenges with respect to both fabrication weldability and the in-service behavior of weldments, many of which are related to the dominant effects of interstitial impurities. This work reviews current understanding of the physical and joining metallurgy of these metals and their alloys with emphasis on fusion welding. Of specific interest are the role of impurities and alloy chemistry in fabrication and service weldability, the material processing route (vacuum melting vs. powder metallurgy), the importance of welding process procedures and variables, weldment mechanical properties, and fracture behavior. Specific examples from the various alloy systems are used to illustrate general metallurgical and joining characteristics of this class of materials. DOE

N92-13434# General Electric Co., Fairfield, CT.
ROLLING ELEMENT BEARING MEMBER Patent
Eric N. Bamberger, inventor, John C. Clark, Jr., inventor, and Alexander H. Nahm, inventor 3 Jul. 1990 31 p
(Patent-1-271-213; Int-Patent-Class-F16C-3330; CTN-91-60234)
Copyright Avail: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec J8X 3X2, Canada HC $4.00 CAN, MF $2.75 CAN

M-50 alloy is a Cr-Mo-V high speed tool steel used extensively in bearings for military and commercial aircraft gas turbine engines. This invention relates to a rolling element bearing comprised of a M-50NiL alloy for use in advanced gas turbine engines. Bearing members with improved life are required for the higher speed, higher temperature environment of advanced gas turbine engines. The bearing in this invention is comprised of a low carbon ductile core having a hardness less than 50 Rockwell C and a carburized hardened layer of hardness in the range 58 - 66 Rockwell C contiguous with the core. The carburized layer includes no greater than 6 percent retained austenite. This bearing has an improved resistance to crack initiation and propagation at a bearing DN

(the bearing bore in millimeters times the shaft speed) of about 2.4 million as a result of compressive residual stress in the carburized layer of about 10-60 ksi. CISTI

N92-13435# National Research Council of Canada, Ottawa (Ontario). Tribology and Mechanics Lab.
SLIDING FRICTION AND WEAR BETWEEN SILICON NITRIDE, ALPHA ALUMINA, AND STEEL (ROUND 2 OF VAMAS WEAR TEST PROGRAM)
H. M. Hawthorne and S. K. Yick Aug. 1988 83 p
(NRC-29843; NRC-TR-TM-008; CTN-91-60289) Copyright Avail: NTIS HC/MF A05

The unlubricated sliding wear and friction behavior of five combinations of silicon nitride, alpha alumina, and AISI 52100 steel specimens in pin-on-disc tests is described. Testing under round robin procedures and conditions ranked the wear by the two parameters, total wear and ball wear, in order of decreasing severity as follows: steel ball vs steel disc, silicon nitride ball vs steel disc, silicon nitride ball vs alumina disc, and steel ball vs silicon nitride disc. Wear severity ranked by width of the disc wear track was almost the same, except that the order of the last two combinations was reversed. Ranking by track depth and profilometric wear was not consistent with the above ranking. Thus it was concluded that for pin-on-disc configuration testing, for the present range of materials at least, wear is best characterized by the total linear and ball wear. Greater steel vs steel wear was observed in the present tests compared with earlier round robin tests. A change in the ambient humidity from 45 to 30 percent was one possible cause of this changed result. CISTI

N92-13436*# Minnesota Univ., Minneapolis.
PERFORMANCE AND STABILITY OF TELEMANIPULATORS USING BILATERAL IMPEDANCE CONTROL Ph.D. Thesis
Christopher Lane Moore 14 Nov. 1991 199 p Sponsored by NASA. Langley Research Center
(NASA-CR-189021; NAS 1.26:189021) Copyright Avail: NTIS HC/MF A09 CSCL 13I

A new method of control for telemanipulators called bilateral impedance control is investigated. This new method differs from previous approaches in that interaction forces are used as the communication signals between the master and slave robots. The new control architecture has several advantages: (1) It allows the master robot and the slave robot to be stabilized independently without becoming involved in the overall system dynamics; (2) It permits the system designers to arbitrarily specify desired performance characteristics such as the force and position ratios between the master and slave; (3) The impedance at both ends of the telerobotic system can be modulated to suit the requirements of the task. The main goals of the research are to characterize the performance and stability of the new control architecture. The dynamics of the telerobotic system are described by a bond graph model that illustrates how energy is transformed, stored, and dissipated. Performance can be completely described by a set of three independent parameters. These parameters are fundamentally related to the structure of the H matrix that regulates the communication of force signals within the system. Stability is analyzed with two mathematical techniques: the Small Gain Theorem and the Multivariable Nyquist Criterion. The theoretical predictions for performance and stability are experimentally verified by implementing the new control architecture on a multidegree of freedom telemanipulator. Author

N92-13437# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
EXPLOITING THE REDUNDANCY OF A HAND-ARM ROBOTIC SYSTEM
Claudio Melchiorri and J. K. Salisbury Oct. 1990 30 p
(Contract N00014-86-K-0685)
(AD-A241161; AI-M-1261) Avail: NTIS HC/MF A03 CSCL 12/9

In this report, a method for exploiting the redundant degrees of freedom of a hand-arm mechanical system for manipulation tasks is illustrated. The basic idea is to try to take advantage of the intrinsic capabilities of the arm and hand subsystems in terms of amplitude of motions, different velocity limits, and degrees of precision for the achievement of a particular task. The Jacobian transpose technique, a well-known algorithm for the solution of the kinematic inverse problem, is at the core of the proposed method for the control of the hand-arm system. Different behaviors of the hand and of the arm are then obtained by means of constraints in Null(J) added to the solution given by the Jacobian transpose method. The constraints are generated by non-orthogonal projection matrices, computed on the basis of the behavior desired from the system, without resorting to extended task space techniques. Comments about the computation of the constraints, and how to take advantage of them, are reported in the paper. GRA

N92-13438# Wright Lab., Wright-Patterson AFB, OH.
COMPARISON OF FATIGUE ENHANCING FASTENER SYSTEMS IN ALUMINUM-LITHIUM MATERIALS Final Report, Jun. 1989 - Nov. 1990
Neal R. Ontko Jul. 1991 69 p
(AD-A241250; WL-TR-91-4053) Avail: NTIS HC/MF A04 CSCL 13/5

Aluminum alloys represent 70 to 80 percent of an aircraft's structural weight. Improvements to structural materials have been concentrated in the areas of increased stiffness and reduction in density. Aluminum-Lithium alloys offer reduction in density of 8 to 10 percent while matching strength and fracture toughness values of traditionally used alloys. These materials have also shown equivalent or superior fatigue performance and a general resistance to corrosion. Although much work has been performed evaluating tensile properties, crack propagation rates, and fracture toughness, very little has been published looking at the material in a fastened state. One of two prime concerns is stress corrosion cracking caused by an imposed stress from radial interference (expansion) in the short transverse grain direction. The second area, fatigue performance, is typically characterized using ASTM type smooth or notched fatigue coupons. These investigations while addressing notched conditions do not take into account fatigue enhancement processes or stress distributions resulting from fastener design. The purpose of this effort was to generate comparative data on the performance of selected fatigue rated fastener systems in Al-Li and a base line alloy 2024. GRA

N92-13439# Massachusetts Inst. of Tech., Cambridge.
PROPULSION OPTIMIZATION FOR ABE, AN AUTONOMOUS UNDERWATER VEHICLE (AUV) M.S. Thesis
Thomas J. Woodford Sep. 1991 102 p
(Contract N00123-89-G-0580)
(AD-A241340) Avail: NTIS HC/MF A06 CSCL 13/10

The oceanographic community is moving towards unmanned autonomous vehicles to gather data and monitor scientific sites. The mission duration of these vehicles is dependent primarily on the power consumption of the propulsion system, the control system and the sensor packages. A customized propulsion thruster is designed. This includes a specialized propeller tailored to ABE and a matched motor and transmission. A non-linear lumped parameter model of the thruster is developed and experimentally verified. The model is used to predict thruster performance and compare the design thruster with other variants of propeller and motor/transmission combinations. The results showed that there is a trade-off between rapid dynamic response and power conservation. For the typical ABE trajectory, the designed thruster provides good dynamic response and the lowest power consumption of all the modelled thruster units. GRA

N92-13440# Ballistic Research Labs., Aberdeen Proving Ground, MD.
VARIOUS TARGET MATERIAL FAILURE MECHANISMS OBSERVED FOR BALLISTIC PENETRATIONS Final Report, Jun. 1990 - Feb. 1991
Timothy G. Farrand Aug. 1991 64 p
(AD-A241555; BRL-TR-3255) Avail: NTIS HC/MF A04 CSCL 19/4

The failure mechanism of a novel target material is compared to existing armor materials, rolled homogeneous armor (RHA) and high hardness armor (HHA), which exhibit two vastly different failure mechanisms. The RHA steel exhibits large bulk plastic deformation as the penetrator burrows into the target. In contrast, the HHA deforms much less as the strain is localized in very small regions that develop into adiabatic shear bands which chip undeformed target material loose during the penetration. Pyromet 718, a nickel superalloy, was chosen to compare different failure mechanisms to the resistance to penetration of the RHA and HHA material. However, it deformed in a manner combining the other two extremes, exhibiting some bulk plastic deformation prior to localizing in deformation bands. The ballistic resistance also appears to lie between the two existing materials with respect to hardness and perhaps, somewhat better for its strength. GRA

N92-13441# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
LABORATORY RESEARCH IN AUTONOMOUS SENSORY PERCEPTION Final Report, 1 Jun. - 30 Sep. 1991
John S. Bay 30 Sep. 1991 17 p
(Contract N00014-91-J-1621)
(AD-A241753) Avail: NTIS HC/MF A03 CSCL 17/8

This report documents the research performed in autonomous sensory perception through automatic sensor based decision making in a robot. The robot's task is to touch simple curved surfaces and estimate their geometric parameters in a completely autonomous fashion with inexpensive sensors. That is, after initial contact, it is to intelligently explore the object so as to understand its shape as quickly as possible. Equipment funded under the grant included several simple sensors and sensor parts, such as a wrist-mounted force/torque sensor, a track-ball transducer, and data acquisition electronics, as well as the high-speed computer host which acts as controller. This equipment was successfully integrated with a Merlin 6540 industrial robot which was programmed to maintain force-controlled contact with miscellaneous curved objects. Also funded was one month of Principal Investigator time and three months of graduate assistant support. The system properly executed the exploration procedure, which is based theoretically upon the estimator uncertainty measure provided by a Kalman filter covariance matrix. GRA

N92-13442# Los Alamos National Lab., NM.
FOUR-WHEEL-DRIVE POWERTRAIN MODELS FOR REAL-TIME SIMULATION
J. S. Freeman and S. A. Velinsky (California Univ., Davis.) 1991 10 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract W-7405-eng-36)
(DE91-016232; LA-UR-91-2473; CONF-911213-5) Avail: NTIS HC/MF A02

Dynamic vehicle powertrain models have been formulated by many researchers for particular applications, mainly the analysis of powertrain characteristics or vibration. In this paper, we formulate models of four-wheel-drive vehicle powertrains for the purpose of real-time simulation. While not encompassing the complete characteristics of powertrain operation, these models are applicable for use in vehicle simulators, and include both the differential and lock-up modes of four-wheel-drive transfer case operation. The models of four-wheel-drive powertrains are applied to a particular vehicle, the U.S. Army High Mobility Multipurpose Wheeled Vehicle (HMMWV), in order to compare and contrast both the simulated vehicle performance and the computational complexity of the models. The HMMWV powertrain incorporates a wide variety of components including: automatic transmission, torque converter, worm-gear differentials, transfer case for both differential and lock-up operation, and final-drive speed reducers at the wheel hubs. Thus, the simulation of this vehicle indicates the wide application of the developed models. DOE

N92-13443# Sandia National Labs., Albuquerque, NM.
AUTOMATED EDGE FINISHING USING AN ACTIVE XY TABLE
G. P. Starr (New Mexico Univ., Albuquerque.) and C. S. Loucks 1991 10 p Presented at the 1st International Congress on Environmentally Conscious Manufacturing, Santa Fe, NM, 18 Sep. 1991
(Contract DE-AC04-76DP-00789)
(DE91-019056; SAND-91-1940C; CONF-9109259-3) Avail: NTIS HC/MF A02

Edge finishing and deburring of parts is a tedious operation that should be automated. This paper describes the use of direct-drive XY table in the automated edge finishing of machined parts. The table is faster and more accurate than an articulated robot; thus where planar motion in a small work area is sufficient, it is preferable. Hybrid force/position control is used to guide the table (with mounted workpiece) past the tool and maintain the contact force at the desired level. A six-axis force sensor on the tool spindle is used to measure contact force. We identified a dynamic model for the table from experimental measurements and used this model to design a force/position controller for the table. An example application of the table in the deburring of an actual jet engine turbine hub is presented. DOE

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-13444*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN AUTOMATED THERMAL VACUUM TEST SYSTEM FOR USE IN ENVIRONMENTAL TESTING OF FLIGHT SYSTEMS AND COMPONENTS
Craig S. Cleckner and Jeffrey R. Knutson Nov. 1991 28 p
(NASA-TM-104140; NAS 1.15:104140) Avail: NTIS HC/MF A03 CSCL 14D

Unusual requirements for the Pressure Distribution/Air Data System (PD/ADS) transducer thermal vacuum testing led to the development of a conductively heated and cooled, fully automated, bell-jar test system. The system has proven to be easily adaptable for other tests and offers the advantages of quick turn-around and low operational cost. Author

N92-13445# Naval Postgraduate School, Monterey, CA.
APPROXIMATE INTERVAL ESTIMATES FOR MECHANICAL RELIABILITY M.S. Thesis
Wen-Huei Yang Sep. 1990 64 p
(AD-A241071) Avail: NTIS HC/MF A04 CSCL 12/3

Two approximate interval estimation procedures for mechanical component reliability, P(X>Y), are developed and their accuracy evaluated by computer simulations. The strength, X, of the component and the stress, Y, applied to it are independent normally distributed variables with unknown means and variances. In the first interval procedure the variances are equal. In the second procedure the variances may be unequal. The derived intervals are quite accurate for the cases simulated which include large and small sample sizes. These procedures are simple to apply and require the use of percentile points of the Student's distribution. In the second procedure, the degrees of freedom of the associated t statistic is a function of the test data, and therefore it is random. GRA

N92-13446# Defense Logistics Agency, Alexandria, VA. Operations Research and Economic Analysis Office.
SAMPLING PLAN DEVELOPMENT IN SUPPORT OF DLA'S QUALITY ASSURANCE LABORATORY TESTING PROGRAM Final Report
Mark S. Melius Sep. 1991 62 p
(AD-A241287; DLA-91-P00204) Avail: NTIS HC/MF A04 CSCL 14/2

The Defense Logistics Agency's Logistics Management Division (DLA-QL) initiated actions to improve DLA's Quality Assurance Program by establishing a program of laboratory testing. However, to effectively implement the program, statistically sound sampling

plans needed to be developed. Such plans would be used by the agency in determining appropriate sampling requirements and confidence levels of estimating material conformance levels. DLA-QL requested analytical support from DLA's Operations Research and Economic Analysis Management Support Office (DORO) in developing the required sampling plans as well as a forecasting tool which would be used in predicting the change in conformance levels over time. This report describes the methodology DORO used in developing the sampling plans and forecasting tool. An analysis of the prototype sampling plans and forecasting tool is also provided. GRA

N92-13447# McDonnell Aircraft Co., Saint Louis, MO.
COMPUTER AIDED ASSESSMENT OF RELIABILITY USING FINITE ELEMENT METHODS Final Report, Jun. 1989 - Dec. 1990
D. A. Followell, S. L. Liguore, R. Perez, and W. E. Yates, III Jul. 1991 228 p
(Contract F30602-89-C-0094)
(AD-A241476; MDC-B2303; RL-TR-91-155) Avail: NTIS HC/MF A11 CSCL 09/1

This report documents the development effort of a desk top reference handbook on how to use Finite Element Analysis (FEA) results to predict electronic device life. The handbook is unique in several areas. Instead of being device oriented, it is oriented toward predicting material life for devices in certain system configurations and environments (i.e., instead of an LCC failure rate calculation, the solder joint fatigue life for an LCC device mounted to a circuit board subjected to a given RMS vibration load will be computed). The handbook contains the most comprehensive material data base available (under one cover) for FEA of electronic devices, and provides step-by-step examples (with number substitutions and units) for every failure mechanism and every material failure algorithm addressable by FEA. The procedures presented in this handbook can be applied to any electronics program to predict the life for electronic devices mounted in high stress areas. Familiarization with FEA procedures is assumed for the user of this handbook; however, guidelines are provided for applying FEA to microscale electronic structures. GRA

N92-13448# Los Alamos National Lab., NM.
MEASUREMENT CONTROL: PRINCIPLES AND PRACTICE AS APPLIED TO NONDESTRUCTIVE ASSAY
T. E. Sampson 1991 8 p Presented at the 4th International Conference on Facility Operations/Safeguards Interface, Albuquerque, NM, 29 Sep. - 4 Oct. 1991
(Contract W-7405-eng-36)
(DE92-000307; LA-UR-91-2879; CONF-910901-13) Avail: NTIS HC/MF A02

This paper discusses the principles and practice of measurement control for nondestructive assay (NDA) instruments. The NDA is not always blessed with the highly controlled samples that are assumed in the analytical laboratory. This adversely affects the use and applicability of the historical error information from instrument stability checks to estimate measurement uncertainties for the broad range of sample characteristics presented to most NDA instruments. This paper emphasizes the methods used to perform instrument stability checks and discusses the resulting uncertainty information that can be derived from these measurements. DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N92-13449 Michigan Univ., Ann Arbor.
SHAPE AND LAYOUT OPTIMIZATION USING HOMOGENIZATION METHOD Ph.D. Thesis
Katsuyuki Suzuki 1991 181 p
Avail: Univ. Microfilms Order No. DA9124116

A generalized shape and layout optimization technique based on the homogenization method is described and applied to the design of two and three dimensional solids and to three dimensional shells. This technique provides an approach to structural optimization that is free of apriori restrictions on the topology as well as shape. The optimization problem is defined as the minimization of the mean compliance while constraining the total material to be used. The same technique is extended to cover cases where multiple load is applied within the given design domain. To determine elastic coefficients of structural materials with microstructure, homogenization theory is used. A resizing rule is formulated on the basis of the optimality criteria method. The ability to predict optimal layout as well as shape was demonstrated via several examples. Convergence of the design with respect to mesh refinement is examined. Stability with respect to mesh distortion is demonstrated. It is shown that different initial material distributions can lead to different final distributions and that the transition of topology is gradual rather than rapid when topology changes with some factors. Several examples are shown for the optimal design of three dimensional shells. The homogenization theory for shells with rapidly changing rib height is presented. Finally, the current optimization technique is applied to problems in a three dimensional domain using three dimensional solid finite elements. Sandwich structure for bending load and box type structure for torsional load are generated. Also, it was demonstrated that the prediction of topology is sensitive to the choice of model for the mechanics. Dissert. Abstr.

N92-13450 Council for National Academic Awards (England).
SHAPE DESIGN SENSITIVITY ANALYSIS AND OPTIMIZATION USING THE BOUNDARY ELEMENT METHOD Ph.D. Thesis
Zhiye Zhao 1990 211 p
Avail: Univ. Microfilms Order No. BRDX92158

The various aspects of shape optimization of two-dimensional continuum structures are investigated, including shape design sensitivity analysis, structural analysis using the boundary element method (BEM) and shape optimization implementation. The developments of shape optimization are reviewed, followed by the presentation of the mathematical programming methods for solving optimization problems. The basic theory of the BEM is presented which is later employed as the numerical tool to provide the structural responses and the shape design sensitivities. The key issue of shape optimization, the shape design sensitivity analysis, is fully investigated. A general formulation of stress sensitivity using the continuum approach is presented. The difficulty of the modeling of the adjoint problem is studied, and two approaches are presented for the modeling of the adjoint problem. The first approach uses distributed loads to smooth the concentrated adjoint loads, and the second approach employs the singularity subtraction method to improve the singular boundary displacements and tractions from the BEM equation. A finite difference based approach to shape design sensitivity is presented, which overcomes the two drawbacks of the conventional finite difference method. This approach has the advantage of being simple in concept, and easier to implement. A shape optimization program for two-dimensional continuum structures is developed, including structural analysis using the BEM, shape design sensitivity analysis, mathematical programming, and the design boundary modeling. Some numerical examples are used to demonstrate the proposed formulations for shape design sensitivity analysis and shape optimization implementation.
Dissert. Abstr.

N92-13451 Virginia Polytechnic Inst. and State Univ., Blacksburg.
ON VIBRATION AND STABILITY PROBLEMS OF LAMINATED PLATES AND SHELLS USING SHEAR DEFORMATION THEORIES Ph.D. Thesis
Asghar Nosier 1991 354 p
Avail: Univ. Microfilms Order No. DA9123744

The vibration and stability analyses of laminated plates and

shells, using classical, first-order and third-order equivalent single-layer theories and the layer-wise theory of Reddy are addressed. Analytical solutions of these theories for natural frequencies and critical buckling loads of plates and shells under various boundary conditions are developed using an improved analytical procedure. A solution for the transient response of viscously damped cross-ply laminated plates, subjected to a sonic-boom type loading, is developed using the third-order shear deformation plate theory of Reddy and the first-order shear deformation plate theory. The nonlinear dynamic equations of the first-order shear deformation plate theory and the third-order shear deformation plate theory of Reddy are reformulated in terms of a pair of equations describing the interior and the edge-zone problems of rectangular plates laminated of transversely isotropic layers. The pure-shear frequencies of the plate in linear and nonlinear problems are identified from the edge-zone equation. For certain boundary conditions, the original system of equations are reduced to three in number, as in the classical plate theory. The frequency and buckling equations of symmetric plates laminated of transversely isotropic layers are obtained using the Levinson's third-order shear deformation plate theory. Using the interior and the edge-zone equations, the frequency and buckling equations are also obtained according to the first-order shear deformation plate theory. The solution contribution of the edge-zone equation is analyzed. By introducing a mixed approach, the bending problem of laminated plates with various boundary conditions is studied according to the first-order and Reddy's third-order shear deformation plate theories. Dissert. Abstr.

N92-13452# National Research Council of Canada, Ottawa (Ontario). Structures and Materials Lab.

QUANTIFYING THE EFFECTS OF ROTATING A LOAD CELL DURING DEADWEIGHT CALIBRATION

P. A. Adams 22 Nov. 1990 21 p
(NAE Proj. 07304)
(NRC-LTR-ST-1807; CTN-91-60274) Copyright Avail: NTIS HC/MF A03

Force sensor calibrations involve the application of known forces to a transducer while its response to those forces is recorded. As force is a vector quantity, and transducers generally have some sensitivity to off-axis inputs, the accepted practice is to carry out two or three repeat determinations and to average the results. Transducer response to rotation of forces about the transducer axis is known to be sinusoidal. The process of averaging the results to arrive at a rotation free baseline sensitivity results from the mathematical properties of equally spaced points along a sinusoidal function. The equations required to extract the amplitude, phase, and baseline are presented. They allow the transducer's rotational response function to be better characterized. In addition to the regular cases of two or three determinations at equally spaced rotational positions, the processes required to handle data from more than three rotational positions or unequal rotational positions are described. A least squares fitting procedure is employed when the number of data points exceeds the number of variables. Two GWBASIC programs designed to solve for unknowns in this calibration are included. CISTI

N92-13453# National Research Council of Canada, Ottawa (Ontario). Structures and Materials Lab.

VERIFICATION OF NISA 2 AND ENDURE FRACTURE MECHANICS CAPABILITY

J. J. Kacprzynski Feb. 1991 128 p Sponsored in part by Dept. of National Defence and Hawker Siddeley Canada Ltd.
(NAE Proj. 07335)
(NRC-ST-621; CTN-91-60275) Avail: NTIS HC/MF A07

In any practical damage tolerance analysis of jet engine components, a very large number of cases must be calculated. Each component must be evaluated for several crack lengths, with varying geometry, and for a large number of load cases. A simple, reliable, accurate, and fast finite element code is required to analyse this data. The code should have good pre-processing and good post-processing capabilities, as well as full 3-D fracture mechanics capabilities. As a potential candidate for this kind of analysis, the general finite element code NISA II and its fracture mechanics module ENDURE, is considered. A very extensive study of the performance of NISA II and ENDURE has been performed using several test cases, including both two and three dimensional cases. The present report contains the most representative results of an analysis of one test case, performed with NISA II, Version 89 and ENDURE, Version 90. It is a study of a double edge cracked tension specimen. The specimen was modeled in two forms: (1) as a two dimensional structure modelled with plane strain elements; and (2) as a three dimensional structure modelled with solid elements. Both models should produce identical results; therefore, this provides a simple way to verify the 3-D capability. The results show that the three dimensional fracture mechanics capability of ENDURE is still imperfect. Both the software and the manual of ENDURE require further upgrading before this code can be used as a fully reliable tool for three dimensional fracture mechanics analysis. CISTI

N92-13454# National Research Council of Canada, Ottawa (Ontario). Structures and Materials Lab.

PRELIMINARY FINITE ELEMENT ANALYSIS OF UNLOADED AND LOADED NOTCHED COMPOSITE LAMINATED PLATES

N. C. Bellinger and C. Poon 19 Nov. 1990 34 p
(Contract DND-FE-C0220788NRC21; NAE Proj. 07336)
(NRC-LTR-ST-1806; CTN-91-60276) Copyright Avail: NTIS HC/MF A03

The lack of stress redistribution in composite laminates is the dominant factor limiting the static strength of composite bolted joints. Bolted joint strength analysis is composed of stress analysis, a failure hypothesis and a failure criterion (strength model). At present, no close-form solutions can accurately predict the stress distribution in the vicinity of the fastener hole. Prior to carrying out a finite element analysis on a composite bolted joint, a preliminary study should be performed on a notched laminated plate which has a stress field similar to the bolted joint in the hole vicinity and the results compared to available closed-form solutions. This paper presents the results from a convergence study on notched laminated plates. A laminated plate with fixed geometry was modelled using the 386PC version of the NISA finite element program to determine the effect that symmetry, and element size and type had on the normal stress distribution. The two dimensional finite element solution was within 3 percent of the values obtained from Whitney and Nuismer's closed-form solutions. The modelling techniques which resulted in accurate stress values were then used to determine the effect of hole diameter and layup on the normal stress distribution of notched laminated plates. These same techniques were also used to model a pin-loaded hole and the results were compared to solutions obtained from a finite element analysis on an identical problem. The results obtained from the NISA finite element program were within 3 percent of the values thereby obtained. Author (CISTI)

N92-13455*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MEASUREMENTS OF FUSELAGE SKIN STRAINS AND DISPLACEMENTS NEAR A LONGITUDINAL LAP JOINT IN A PRESSURIZED AIRCRAFT

Edward P. Phillips and Vicki O. Britt Oct. 1991 29 p
(NASA-TM-104163; NAS 1.15:104163) Avail: NTIS HC/MF A03 CSCL 20K

Strains and displacements in a small area near a longitudinal lap joint in the fuselage skin of a B737 aircraft were measured during a pressurization cycle to a differential pressure of 6.2 psi while the aircraft was on the ground. It was found that hoop strains were higher than longitudinal strains at each location; membrane strains in the unreinforced skin were higher than in the joint; membrane strains in the hoop direction, as well as radial displacements, tended to be highest at the mid-bay location between skin reinforcements; significant bending in the hoop direction occurred in the joint and in the skin near the joint, and the bending was unsymmetrically distributed about the stringer at the middle of the joint; and radial displacements were unsymmetrically distributed across the lap joint. The interpretation

of the strain gage data for locations on the bonded and riveted lap joint assumed that the joint did not contain disbonded areas. Author

N92-13456*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
THE FIRST ANDES ELEMENTS: 9-DOF PLATE BENDING TRIANGLES Final Report, Dec. 1989
Carmelo Militello and Carlos A. Felippa Cleveland, OH NASA Nov. 1991 35 p Sponsored in part by Consejo Nacional de Investigaciones Cientificas y Tecnicas
(Grants NAG3-934; NSF ASC-87-17773)
(NASA-CR-189068; NAS 1.26:189068) Avail: NTIS HC/MF A03 CSCL 20K

New elements are derived to validate and assess the assumed natural deviatoric strain (ANDES) formulation. This is a brand new variant of the assumed natural strain (ANS) formulation of finite elements, which has recently attracted attention as an effective method for constructing high-performance elements for linear and nonlinear analysis. The ANDES formulation is based on an extended parametrized variational principle developed in recent publications. The key concept is that only the deviatoric part of the strains is assumed over the element whereas the mean strain part is discarded in favor of a constant stress assumption. Unlike conventional ANS elements, ANDES elements satisfy the individual element test (a stringent form of the patch test) a priori while retaining the favorable distortion-insensitivity properties of ANS elements. The first application of this formulation is the development of several Kirchhoff plate bending triangular elements with the standard nine degrees of freedom. Linear curvature variations are sampled along the three sides with the corners as gage reading points. These sample values are interpolated over the triangle using three schemes. Two schemes merge back to conventional ANS elements, one being identical to the Discrete Kirchhoff Triangle (DKT), whereas the third one produces two new ANDES elements. Numerical experiments indicate that one of the ANDES element is relatively insensitive to distortion compared to previously derived high-performance plate-bending elements, while retaining accuracy for nondistorted elements. Author

N92-13457*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.
AN UNCONDITIONALLY STABLE STAGGERED ALGORITHM FOR TRANSIENT FINITE ELEMENT ANALYSIS OF COUPLED THERMOELASTIC PROBLEMS Final Report, Jul. 1989
C. Farhat, K. C. Park, and Y. Dubois-Pelerin (Ecole Polytechnique Federale de Lausanne, Switzerland) Nov. 1991 26 p
(Grants NAG3-934; NAGw-1388)
(NASA-CR-189066; NAS 1.26:189066) Avail: NTIS HC/MF A03 CSCL 20K

An unconditionally stable second order accurate implicit-implicit staggered procedure for the finite element solution of fully coupled thermoelasticity transient problems is proposed. The procedure is stabilized with a semi-algebraic augmentation technique. A comparative cost analysis reveals the superiority of the proposed computational strategy to other conventional staggered procedures. Numerical examples of one and two-dimensional thermomechanical coupled problems demonstrate the accuracy of the proposed numerical solution algorithm. Author

N92-13458*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TECHNICAL ACTIVITIES OF THE CONFIGURATION AEROELASTICITY BRANCH
Stanley R. Cole, ed. Oct. 1991 197 p
(NASA-TM-104146; NAS 1.15:104146) Avail: NTIS HC/MF A09 CSCL 20K

A number of recent technical activities of the Configuration Aeroelasticity Branch of the NASA Langley Research Center are discussed in detail. The information on the research branch is compiled in twelve separate papers. The first of these topics is a summary of the purpose of the branch, including a full description of the branch and its associated projects and program efforts. The next ten papers cover specific projects and are as follows: Experimental transonic flutter characteristics of supersonic cruise configurations; Aeroelastic effects of spoiler surfaces mounted on a low aspect ratio rectangular wing; Planform curvature effects on flutter of 56 degree swept wing determined in Transonic Dynamics Tunnel (TDT); An introduction to rotorcraft testing in TDT; Rotorcraft vibration reduction research at the TDT; A preliminary study to determine the effects of tip geometry on the flutter of aft swept wings; Aeroelastic models program; NACA 0012 pressure model and test plan; Investigation of the use of extension twist coupling in composite rotor blades; and Improved finite element methods for rotorcraft structures. The final paper describes the primary facility operation by the branch, the Langley TDT. Author

N92-13459*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ON MARKOV PARAMETERS IN SYSTEM IDENTIFICATION
Minh Phan, Jer-Nan Juang, and Richard W. Longman (Columbia Univ., New York, NY.) Oct. 1991 32 p
(NASA-TM-104156; NAS 1.15:104156) Avail: NTIS HC/MF A03 CSCL 20K

A detailed discussion of Markov parameters in system identification is given. Different forms of input-output representation of linear discrete-time systems are reviewed and discussed. Interpretation of sampled response data as Markov parameters is presented. Relations between the state-space model and particular linear difference models via the Markov parameters are formulated. A generalization of Markov parameters to observer and Kalman filter Markov parameters for system identification is explained. These extended Markov parameters play an important role in providing not only a state-space realization, but also an observer/Kalman filter for the system of interest. Author

N92-13460*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA. Aerostructures Directorate.
DETAILED ANALYSIS AND TEST CORRELATION OF A STIFFENED COMPOSITE WING PANEL
D. Dale Davis, Jr. Sep. 1991 19 p Presented at the 17th European Rotorcraft Forum, Berlin, Germany, 24-26 Sep. 1991 Prepared in cooperation with Army Aviation Systems Command, Hampton, VA
(NASA-TM-104154; NAS 1.15:104154; AVSCOM-TR-91-B-015)
Avail: NTIS HC/MF A03 CSCL 20K

Nonlinear finite element analysis techniques are evaluated by applying them to a realistic aircraft structural component. A wing panel from the V-22 tiltrotor aircraft is chosen because it is a typical modern aircraft structural component for which there is experimental data for comparison of results. From blueprints and drawings supplied by the Bell Helicopter Textron Corporation, a very detailed finite element model containing 2284 9-node Assumed Natural-Coordinate Strain (ANS) elements was generated. A novel solution strategy which accounts for geometric nonlinearity through the use of corotating element reference frames and nonlinear strain displacements relations is used to analyze this detailed model. Results from linear analyses using the same finite element model are presented in order to illustrate the advantages and costs of the nonlinear analysis as compared with the more traditional linear analysis. Strain predictions from both the linear and nonlinear stress analyses are shown to compare well with experimental data up through the Design Ultimate Load (DUL) of the panel. However, due to the extreme nonlinear response of the panel, the linear analysis was not accurate at loads above the DUL. The nonlinear analysis more accurately predicted the strain at high values of applied load, and even predicted complicated nonlinear response characteristics, such as load reversals, at the observed failure load of the test panel. In order to understand the failure mechanism of the panel, buckling and first ply failure analyses were performed. The buckling load was 17 percent above the observed failure load while first ply failure analyses indicated significant material damage at and below the observed failure load. Author

N92-13461*# Southwest Research Inst., San Antonio, TX.
PROBABILISTIC STRUCTURAL ANALYSIS METHODS (PSAM) FOR SELECT SPACE PROPULSION SYSTEM COMPONENTS Annual Report No. 4
Cleveland, OH NASA Oct. 1991 372 p
(Contract NAS3-24389)
(NASA-CR-187198; NAS 1.26:187198; SWRI-06-8339) Avail: NTIS HC/MF A16 CSCL 20K

The fourth year of technical developments on the Numerical Evaluation of Stochastic Structures Under Stress (NESSUS) system for Probabilistic Structural Analysis Methods is summarized. The effort focused on the continued expansion of the Probabilistic Finite Element Method (PFEM) code, the implementation of the Probabilistic Boundary Element Method (PBEM), and the implementation of the Probabilistic Approximate Methods (PAppM) code. The principal focus for the PFEM code is the addition of a multilevel structural dynamics capability. The strategy includes probabilistic loads, treatment of material, geometry uncertainty, and full probabilistic variables. Enhancements are included for the Fast Probability Integration (FPI) algorithms and the addition of Monte Carlo simulation as an alternate. Work on the expert system and boundary element developments continues. The enhanced capability in the computer codes is validated by applications to a turbine blade and to an oxidizer duct. Author

N92-13462*# California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
ELASTO-PLASTIC ANALYSIS OF INTERFACE LAYERS FOR FIBER REINFORCED METAL MATRIX COMPOSITES Final Report
I. Doghri and F. A. Leckie Jun. 1991 41 p
(Grant NAG3-894)
(NASA-CR-187133; NAS 1.26:187133) Avail: NTIS HC/MF A03 CSCL 20K

The mismatch in coefficients of thermal expansion (CTE) of fiber and matrix in metal matrix composites reinforced with ceramic fibers induces high thermal stresses in the matrix. Elasto-plastic analyses - with different degrees of simplification and modelization - show that an interface layer with a sufficiently high CTE can reduce the tensile hoop stress in the matrix substantially. Author

N92-13463*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences and Center for Space Structures and Controls.
DEVELOPMENTS IN VARIATIONAL METHODS FOR HIGH PERFORMANCE PLATE AND SHELL ELEMENTS Final Report, Jun. 1989
Carlos A. Felippa and Carmelo Militello Nov. 1991 27 p
Previously announced in IAA as A90-46288
(Grant NAG3-934)
(NASA-CR-189065; NAS 1.26:189065) Avail: NTIS HC/MF A03 CSCL 20K

High performance elements are simple finite elements constructed to deliver engineering accuracy with coarse arbitrary grids. This is part of a series on the variational foundations of high-performance elements, with emphasis on plate and shell elements constructed with the free formulation (FF) and assumed natural strain (ANS) methods. Parameterized variational principles are studied that provide a common foundation for the FF and ANS methods, as well as for a combination of both. From this unified formulation a variant of the ANS formulation, called the assumed natural deviatoric strain (ANDES) formulation, emerges as an important special case. The first ANDES element, a high-performance 9 degrees of freedom triangular Kirchhoff plate bending element, is briefly described to illustrate the use of the new formulation. Author

N92-13464# CEMCOM Research Associates, Inc., Lanham, MD.
A MECHANISTIC STUDY OF FAILURE OF CONCRETE SUBJECTED TO CYCLIC THERMAL LOADS Final Report, May 1990 - Feb. 1991
Thomas A. Bier, Sean Wise, and Peter Chang Jul. 1991 68 p
(Contract N47408-90-C-1147)
(AD-A241206) Avail: NTIS HC/MF A04 CSCL 13/2

This project was aimed at understanding the behavior of normal weight concrete subjected to cyclic thermal loading. It includes experimental and analytical work with emphasis on thermal strain incompatibilities between cement paste and aggregates due to different coefficients of thermal expansion. The report describes a study to investigate mechanisms which lead to fatigue failure of concrete pavement surfaces due to their repeated exposure to the hot exhaust gases of the auxiliary power unit (APU) of F/A-18 aircraft. The experimental results show a degradation of the microstructure and the mechanical properties with thermal cycling. Analytical modeling was used to calculate temperature and stress distributions in a concrete which is heated on the surface by a hot air stream. From the analysis and discussion of the results, a hypothesis for a heat fatigue failure mechanism was developed. This mechanism is the creation and propagation of microcracks in the concrete. The cracks are mostly caused by drying shrinkage and lead to a scaling of the concrete surface. Four methods are proposed to modify concretes to achieve a better heat resistance when exposed to thermal cycling. GRA

N92-13465# Zak Technologies, Inc., Champaign, IL.
FINITE ELEMENT MODEL FOR GAP CONTACT PROBLEMS Final Report, Oct. 1983 - Aug. 1984
Adam R. Zak Aug. 1991 67 p
(DA Proj. 1L1-62618-AH-80)
(AD-A241237; BRL-CR-674) Avail: NTIS HC/MF A04 CSCL 20/11

A finite element model is developed for structural analysis of axisymmetric geometries with surface contact. The contact occurs when small gaps exist between adjacent parts of the structure and these gaps are closed during the loading cycle. In the model, this phenomenon is simulated by special gap finite elements. Originally, the gap elements have relatively low stiffness, and as surface contact is obtained, the stiffness matrix of these elements is modified to simulate very stiff response in the direction of the contact. The finite element model allows for elastic-plastic and elastic-viscoplastic materials with isotropic or orthotropic properties. The axisymmetric configuration allows for three displacement components in the cylindrical coordinates. GRA

N92-13466# Wright Lab., Wright-Patterson AFB, OH.
PROCEEDINGS OF DAMPING 1991, VOLUME 1 Final Report, Feb. 1989 - Feb. 1991
Aug. 1991 393 p Conference held in San Diego, CA, 13-15 Feb. 1991
(AF Proj. 2401)
(AD-A241311; WL-TR-91-3078-Vol-1) Avail: NTIS HC/MF A17 CSCL 20/11

The topics covered include the following: viscoelastic material testing and characterization, passive damping concepts, passive damping analysis and design techniques, optimization, damped control/structure interaction, viscous dampers, friction damping, other vibration suppression techniques, damping identification and dynamic testing, applications to aircraft, space structures, marine structures, commercial products, defense applications, and payoffs of vibrational suppression. GRA

N92-13467# Wright Lab., Wright-Patterson AFB, OH.
PROCEEDINGS OF DAMPING 1991, VOLUME 2 Final Report, Feb. 1989 - Feb. 1991
Aug. 1991 560 p Conference held in San Diego, CA, 13-15 Feb. 1991
(AF Proj. 2401)
(AD-A241312; WL-TR-91-3078-Vol-2) Avail: NTIS HC/MF A24 CSCL 20/11

The topics covered include the following: viscoelastic material testing and characterization, passive damping concepts, passive damping analysis and design techniques, optimization, damped control/structure interaction, viscous dampers, friction damping, other vibration suppression techniques, damping identification and

dynamic testing, applications to aircraft, space structures, marine structures, commercial products, defense applications, and payoffs of vibration suppression. GRA

N92-13468# Naval Postgraduate School, Monterey, CA.
VIBRATION OF A CANTILEVER BEAM THAT SLIDES AXIALLY IN A RIGID FRICTIONLESS HOLE M.S. Thesis
Mark R. DeVries Sep. 1990 123 p
(AD-A241352) Avail: NTIS HC/MF A06 CSCL 20/11

In 1979, Boresi and Salinas prepared a report that formulates the problem and proposes a solution procedure. The report was the result of an interest in the transient behavior of a gun barrel during recoil following firing. This research considers a cantilever beam which can move axially in and out of a rigid frictionless hole and is free to vibrate laterally outside the hole. Two Euler equations describing the lateral and axial motion of the beam are presented. A transformation of coordinates to eliminate the moving boundary, and spatial non dimensionalization are used to transform the problem into a system of two coupled nonlinear partial differential equations with a fixed domain. A finite element formulation provides a numerical solution to the problem. GRA

N92-13469# Naval Postgraduate School, Monterey, CA.
DESIGN OPTIMIZATION OF BLADE STIFFENED LAMINATED COMPOSITE PLATES FOR MAXIMUM BUCKLING LOAD M.S. Thesis
Mark R. Achenbach Dec. 1990 98 p
(AD-A241651) Avail: NTIS HC/MF A05 CSCL 20/11

The buckling load of a blade stiffened laminated composite plate having midplane symmetry is maximized for a given total weight. The thickness of the layers and the width and height of the stiffener are taken as the design variables. Buckling analysis is carried out using a finite element method. The optimization problem is solved using commercially available optimization packages. Due to the highly nonlinear nature of the optimality equations, several local optimum solutions are found. To examine the relationship between the number of local optimums and their relative magnitudes, various combinations of fiber orientation for the laminate layers and the blade stiffener are investigated. GRA

N92-13470# CSA Engineering, Inc., Palo Alto, CA.
PRESERVATION AND UTILIZATION OF FINITE ELEMENT MODELS OF USAF AIRCRAFT STRUCTURES Final Report, Mar. 1989 - Dec. 1990
Warren C. Gibson and Gordon N. Negaard 23 Aug. 1991 80 p
(Contract F33615-89-C-3205)
(AD-A241657; CSA-91-01-02; WL-TR-91-3055) Avail: NTIS HC/MF A05 CSCL 12/1

The problem addressed by this report is that the Air Force is not getting full value for the resources expended in the development of finite element models of USAF aircraft structures, both directly and by contractors. Models developed by airframe contractors are usually not made available to the Air Force. Models that are available are often inadequately documented or verified, or their existence may be unknown to those who need them. The problem was assessed by a survey of Air Force organizations and was attacked in three ways. First, software called FEM-X was developed for storage and retrieval of finite element model data along with descriptive information about the data. The software could be used by an Air Force Finite Element Model Center. A proposal for establishment of this Center is the second aspect of modification, and distribution of aircraft models. The third subject addressed by the report is a Mil Standard that is proposed for delivery of finite element models by Air Force contractors. GRA

N92-13471# Ballistic Research Labs., Aberdeen Proving Ground, MD.
CRACK PATH PREDICTION NEAR AN ELLIPTICAL INHOMOGENEITY Final Report, Jun. 1989 - Apr. 1991
Edward M. Patton Sep. 1991 131 p
(DA Proj. 1L1-62618-AH-80)
(AD-A241798; BRL-TR-3277) Avail: NTIS HC/MF A07 CSCL 20/11

In this work, a new technique is presented which will predict the path of a naturally growing crack near a rigid elliptical inclusion, where the stress field can be modelled as two dimensional. The technique uses a boundary integral approach to the solution of the stress field at the tips of the crack which is in general not straight, and is interacting with a rigid elliptical inclusion. The crack is parameterized as a cubic spline, and the results of both a Green's Function solution to the interaction of a dislocation with an elliptical inclusion, and a first order perturbation solution to account for the generally curvilinear nature of the crack have been employed. The singular nature of the stresses is accounted for using a numerical technique which describes the distribution of dislocations along the crack as a piecewise quadratic polynomial to transform the problem's resulting integral equations into algebraic equations well suited to a matrix-type solution. Results of each step of the analysis have been verified with previously published results, and with experimental results of a crack propagating near an open circular hole. New and significant results are also presented as paths of cracks interacting with inclusions of differing ellipticity ratios, and at different orientations with respect to the initial crack. GRA

N92-13472# Pacific Northwest Lab., Richland, WA.
MICROSTRUCTURES AND MECHANICAL BEHAVIOR OF MOLLUSK SHELLS
V. J. Laraia and A. H. Heuer (Case Western Reserve Univ., Cleveland, OH.) Mar. 1991 19 p Presented at the 11th Riso International Symposium on Metallurgy and Materials Science: Structural Ceramics Processing Microstructure and Properties, Riso, Denmark, 3-7 Sep. 1990
(Contract DE-AC06-76RL-01830)
(DE91-018824; PNL-SA-19901; CONF-9009185-1) Avail: NTIS HC/MF A03

Biological hard tissues are load-bearing structural materials, composed of a mineral (ceramic) component and an organic (protein) component. The microstructures of three composite designs commonly found in mollusk shells, the nacreous, foliated, and crossed-lamellar structures are discussed. Although all of these can be viewed as laminar composites, differences exist in the morphology, crystal structure, defect microstructure, and spatial organization of the mineral, CaCO3. Electron microscopy investigations of these materials reveal a variety of crystallographic defects, the details of which have been used to refine existing models for biomineralization in these tissues. Flexural strengths in four-point bending are on the order of 100 Mpa. Examples of graceful failure, i.e., stable crack growth in bulk samples, in the crossed-lamellar and foliated structures, are reported. Fractography of such specimens reveals that a number of familiar toughening mechanisms operate together to produce this desirable structural flaw tolerance. Even more unusual is the fact that mollusk shells are harder than the native minerals from which they are made. The damage zones and the anisotropy of hardness suggest an explanation for the anomalous hardness based on microstructural design rather than on intrinsic hardening of the mineral phase. DOE

N92-13473# Sandia National Labs., Albuquerque, NM.
FATIGUE LIFE PREDICTION OF SOLDER JOINTS
W. B. Jones 10 Sep. 1991 21 p Presented at the Fall Meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE91-019058; SAND-91-2078C; CONF-911003-16) Avail: NTIS HC/MF A03

The current status of lifetime prediction under conditions of thermomechanical creep/fatigue is reviewed. Each method is summarized and the results of the application to solder joints is shown. While each method has been applied with some success, a predictive, phenomenological approach has not been developed

and validated. A method which captures the response of a crack to steady-state and cycling environments appears to hold most the most promise to provide a useful design tool. DOE

N92-13839*# Norfolk State Univ., VA. Dept. of Chemistry and Physics.
EXPERIMENTAL DETERMINATION OF RESIDUAL STRESS
Milton W. Ferguson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 100-102 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20K

42 GEOSCIENCES (GENERAL)

N92-13474# Coastal Engineering Research Center, Vicksburg, MS.
DATA SUMMARY FOR 1989 CERC FIELD RESEARCH FACILITY. VOLUME 1: MAIN TEXT AND APPENDIXES A AND B Final Annual Report
Aug. 1991 123 p
(AD-A241586; CERC-TR-91-9-Vol-1) Avail: NTIS HC/MF A06 CSCL 08/3

This report provides basic data and summaries for the measurements made during 1989 at the U.S. Army Engineer Waterways Experiment Station (WES) Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) in Duck, NC. The report includes comparisons of the present year's data with cumulative statistics from 1980 to the present. The report summarizes meteorological and oceanographic data, monthly bathymetric survey results, samples of quarterly aerial photography, and descriptions of 17 storms that occurred during the year. The year was highlighted by a severe storm in March that destroyed or damaged over 100 ocean front structures. Waves with 4-m significant height were measured 6 km from shore. This report is eleventh in a series of annual summaries of data collected at the FRF that began with Miscellaneous Report CERC-82-16, which summarizes data collected during 1977-1979. GRA

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-13475 Columbia Univ., New York, NY.
LANDSAT MEASUREMENT OF GREEN VEGETATION COVER IN A HETEROGENEOUS LANDSCAPE Ph.D. Thesis
Helene Wilson 1990 192 p
Avail: Univ. Microfilms Order No. DA9118663

If quantitative relationships between satellite derived visible/near infrared vegetation indexes (VNVIs) and vegetation quantity can be extrapolated to regional, continental, or global areas, important contributions to monitoring and modelling of climatic and hydrologic processes, biological production, and biogeochemical fluxes would ensue. However, the stability of VNVI vegetation relationships across different landscapes is not known. The use of VNVIs as universal measures of vegetation quantity is based on the assumption that green vegetation has unique and unvarying spectral features. One indicator of the stability of VNVI measurement of vegetation with surface variation is the strength of the VNVI vegetation relationship in a heterogeneous landscape. This study examined the relation between two representative LANDSAT MSS VNVI transformations and fractional green vegetation cover in a New England urban-suburban summer landscape characterized by a wide range of land cover diversity at sub-pixel scale. The LANDSAT image was precisely registered to 1:12,000 color infrared aerial photography, from which surface characteristics were densely sampled for 504 pixels. Surface variations in the sampled pixels included variable species, morphology, shadowing, and spatial pattern of green and non-green vegetation, as well as variable ground surface type, brightness, and shadowing. A simple linear relation explained 84 and 87 percent of the variance between the n-space greenness vegetation index and the normalized difference vegetation index, respectively, and total fraction of a pixel covered by green vegetation, including herbaceous, woody, and shadowed components. This strong relation lends support to the idea that a VNVI is a measure of green vegetation that transcends vegetation and other surface categorizations. Dissert. Abstr.

N92-13476*# Massachusetts Inst. of Tech., Cambridge. Dept. of Engineering.
THE IMPLEMENTATION AND VALIDATION OF IMPROVED LANDSURFACE HYDROLOGY IN AN ATMOSPHERIC GENERAL CIRCULATION MODEL
Kevin D. Johnson, Dara Entekhabi, and Peter S. Eagleson Oct. 1991 193 p
(Grant NAG5-743)
(NASA-CR-189488; NAS 1.26:189488; R91-23; MIT-TR-334)
Avail: NTIS HC/MF A09 CSCL 08H

Landsurface hydrological parameterizations are implemented in the NASA Goddard Institute for Space Studies (GISS) General Circulation Model (GCM). These parameterizations are: (1) runoff and evapotranspiration functions that include the effects of subgrid scale spatial variability and use physically based equations of hydrologic flux at the soil surface, and (2) a realistic soil moisture diffusion scheme for the movement of water in the soil column. A one dimensional climate model with a complete hydrologic cycle is used to screen the basic sensitivities of the hydrological parameterizations before implementation into the full three dimensional GCM. Results of the final simulation with the GISS GCM and the new landsurface hydrology indicate that the runoff rate, especially in the tropics is significantly improved. As a result, the remaining components of the heat and moisture balance show comparable improvements when compared to observations. The validation of model results is carried from the large global (ocean and landsurface) scale, to the zonal, continental, and finally the finer river basin scales. Author

N92-13477# Coastal Engineering Research Center, Vicksburg, MS.
EVALUATION OF THE COASTAL FEATURES MAPPING SYSTEM FOR SHORELINE MAPPING Final Report
Steven G. Underwood and Fred J. Anders Sep. 1991 48 p
(AD-A241289; CERC-91-13) Avail: NTIS HC/MF A03 CSCL 08/2

Since many coastal areas are subject to frequent change due to environmental conditions or commercial development, it is often difficult to fulfill the optimum requirements for ground control when mapping from aerial photographs. For this reason, a series of tests were devised to evaluate the accuracy of the Coastal Features Mapping System (CFMS) for typical shoreline mapping applications encountered by the U.S. Army Corps of Engineers. Major variables tested included the number of ground control points (GCP's) employed in the solution and their distribution. Ground control points digitized from 1:24,000 scale U.S. Geological Survey topographic maps were used in various combinations to orient 1:9,600 scale aerial photographs for coordinate retrieval. It was found that the accuracy of X-, Y-coordinates determined from the photographs is governed by the distribution and accuracy of GCP's. Maximum accuracy is obtained when all measured points are within the area bounded by the GCP's. Although at least four GCP's are required for the solution, additional points allow possible mistakes to be identified and corrected interactively. In all tests, the errors were consistent with those associated with 1:24,000 scale base map as defined by National Map Accuracy Standards. The user's guide contained adequate information about overall program operation, but lacked sufficient guidance for first time users. GRA

N92-13478*# George Washington Univ., Washington, DC. Dept. of Electrical Engineering and Computer Science.
DISCRETE RANDOM MEDIA TECHNIQUES FOR MICROWAVE MODELING OF VEGETATED TERRAIN Final Report, Aug. 1982 - May 1990
Roger H. Lang Sep. 1991 24 p
(Grant NAG5-265)
(NASA-CR-188472; NAS 1.26:188472) Avail: NTIS HC/MF A03 CSCL 02F

Microwave remote sensing models of vegetated terrain are investigated. The problem is to determine canopy characteristics such as biomass, canopy height, and the moisture of the underlying soil. The report describes a discrete scatter model which has been employed to model backscatter in the active (radar) case and to model brightness temperature in the passive (radiometric) case. The acquisition of ground truth data is discussed, as well as the comparison of theory and experiment. The overall conclusion of the work has been that the discrete scatter model in conjunction with efficient scatter algorithms and the distorted Born approximation is a most appropriate methodology to use for modeling purposes in the microwave region. Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-13479# Illinois Inst. of Tech., Chicago. Dept. of Chemical Engineering.
ELECTRODE REACTION MECHANISMS IN MOLTEN CARBONATE FUEL CELLS
J. R. Selman, T. Nishina, Y. P. Lin, E. B. Yeager, and D. A. Tryk Jul. 1989 154 p Prepared in cooperation with Case Western Reserve Univ., Cleveland, OH
(Contract DE-AC21-86MC-23266)
(DE90-009651; DOE/MC-23266/2841) Avail: NTIS HC/MF A08

This report describes the results of a joint research effort at Illinois Institute of Technology (IIT) and Case Western Reserve University (CWRU) to elucidate the reaction mechanism of oxygen reduction at the cathode of the molten carbonate fuel cell (MCFC). This research project was aimed at developing novel experimental approaches to the chemistry and electrode kinetics of oxygen reduction under MCFC conditions, and improving our fundamental understanding of the reaction mechanism as it applies to the MCFC. IIT's contribution was focused on developing and using rotating electrodes with well-defined mass-transfer properties, to characterize the electrode kinetics of oxygen reduction in molten carbonate. CWRU's contribution was focused on developing and using micro-electrodes for the same purpose, and also on developing spectroscopic cells and carrying out various types of spectroscopic measurements to characterize the oxygen species in molten carbonate under MCFC conditions. This report is divided into two main parts. Part 1 provides the technical background of the questions concerning oxygen reduction in molten carbonate as they apply to the MCFC system. The methodological approach and the objectives of the research are also presented. The second part describes the development of the rotating electrodes, micro-electrodes and spectroscopic cells and the results of measurements, as well as the interpretation of the data. Conclusions of this project, including some recommendations for further research, are also given in this part. DOE

N92-13480# Oak Ridge National Lab., TN.
CONSERVATION AND RENEWABLE ENERGY PROGRAM
K. H. Vaughan Apr. 1990 118 p
(Contract DE-AC05-84OR-21400)
(DE90-011297; ORNL/CON-302) Avail: NTIS HC/MF A06

This bibliography lists reports and selected papers published under the Oak Ridge National Laboratory Conservation and Renewable Energy Program from 1986 through February 1990. Most of the documents in the bibliography are available from Oak Ridge National Laboratory. DOE

N92-13481# Central Research Inst. of Electric Power Industry, Chiba (Japan).
DEVELOPMENT OF CATALYST FOR FUEL CELLS BY MIMICKING BIO-MATERIALS
Hiroshi Saiki Jul. 1989 22 p In JAPANESE; ENGLISH summary
(DE90-503394; CRIE-U-89001) Avail: NTIS (US Sales Only) HC A03

The development of fuel cells has been one of technological innovations in energy conversion field. The fuel cells using phosphoric acid as electrolyte need platinum which is rare metal and expensive; therefore, an alternative catalyst instead of platinum has been sought. On the other hand, the respiratory reactions in a mammal include a reduction in which molecular oxygen is converted into water; this reaction is very similar to the role of an oxygen electrode of fuel cells. A porphyrin derivative which has a similar structure to cytochrome C, which is respiratory enzyme, was synthesized to study possibility of application in the catalyst of the oxygen electrode reaction. A glassy carbon electrode was prepared by coating with a layer of the porphyrin derivative. Catalytic activities in the reduction of molecular oxygen, which is supplied from air, were examined using the porphyrin derivative. The carbon electrode covered with the porphyrin catalyzed the reduction of molecular oxygen to water. These results suggest that this porphyrin can act as catalyst of fuel cells. DOE

N92-13482*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A VERY LOW RESISTANCE, NON-SINTERED CONTACT SYSTEM FOR USE ON INDIUM PHOSPHIDE CONCENTRATOR/SHALLOW JUNCTION SOLAR CELLS
Victor G. Weizer and Navid S. Fatemi (Sverdrup Technology, Inc., Brook Park, OH.) Oct. 1991 9 p Presented at the 22nd Photovoltaic Specialists Conference, Las Vegas, NV, 7-11 Oct. 1991; sponsored by IEEE
(NASA-TM-105279; E-6604; NAS 1.15:105279) Avail: NTIS HC/MF A02 CSCL 10A

An investigation is made into the possibility of providing low resistance contacts to shallow junction InP solar cells which do not require sintering and which do not cause device degradation even when subjected to extended annealing at elevated temperatures. We show that the addition of In to Au contacts in amounts that exceed the solid solubility limit lowers the as-fabricated (unsintered) contact resistivity (R sub c) to the 10(exp -5) ohm cm(exp 2) range. We next consider the contact system Au/Au2P3, which has been shown to exhibit as-fabricated R sub c values in the 10(exp -6) ohm cm(exp 2) range, but which fails quickly when heated. We show that the substitution of a refractory metal (W, Ta) for Au preserves the low R sub c values while preventing the destructive reactions that would normally take place in this system at high temperatures. We show, finally, that R sub c values in the 10(exp -7) ohm cm(exp 2) range can be achieved without sintering by combining the effects of In or Ga additions to Au contacts with the effects of introducing a thin Au2P3 layer at the metal-InP interface. Author

N92-13483*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF KOH CONCENTRATION ON LEO CYCLE LIFE OF IPV NICKEL-HYDROGEN FLIGHT CELLS-UPDATE 2
John J. Smithrick and Stephen W. Hall (Naval Weapons Support Center, Crane, IN.) 1991 11 p Proposed for presentation at the Seventh Annual Battery Conference on Applications and Advances, Long Beach, CA, 21-23 Jan. 1992; sponsored by California State Univ.
(NASA-TM-105314; E-6667; NAS 1.15:105314) Avail: NTIS HC/MF A03 CSCL 10B

An update of validation test results confirming the breakthrough in low earth orbit (LEO) cycle life of nickel-hydrogen cells containing 26 percent KOH electrolyte is presented. A breakthrough in the LEO cycle life of individual pressure vessel (IPV nickel-hydrogen cells has been previously reported. The cycle life of boiler plate cells containing 26 percent potassium hydroxide (KOH) electrolyte was about 40 000 LEO cycles compared to 3500 cycles for cells containing 31 percent KOH. This test was conducted at Hughes Aircraft Company under a NASA Lewis contract. The purpose was to investigate the effect of KOH concentration on cycle life. The cycle regime was a stressful accelerated LEO, which consisted of a 27.5 min charge followed by a 17.5 min discharge (2x normal rate). The depth of discharge (DOD) was 80 percent. The cell temperature was maintained at 23 C. The boiler plate test results are in the process of being validated using flight hardware and real time LEO test at the Naval Weapons Support Center (NWSC), Crane, Indiana under a NASA Lewis Contract. Six 48 Ah Hughes recirculation design IPV nickel-hydrogen flight battery cells are being evaluated. Three of the cells contain 26 percent KOH (test cells), and three contain 31 percent KOH (control cells). They are undergoing real time LEO cycle life testing. The cycle regime is a 90-min LEO orbit consisting of a 54-min charge followed by a 36-min discharge. The depth-of-discharge is 80 percent. The cell temperature is maintained at 10 C. The three 31 percent KOH cells failed (cycles 3729, 4165, and 11355). One of the 26 percent KOH cells failed at cycle 15314. The other two 26 percent KOH cells were cycled for over 16600 cycles during the continuing test. Author

N92-13484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPEDANCES OF Li/SO2 CELLS RETRIEVED FROM THE LONG DURATION EXPOSURE FACILITY (LDEF SATELLITE) AND COMPARISON WITH CELLS STORED TERRESTRIALLY
Margaret A. Reid Nov. 1991 9 p
(NASA-TM-104526; E-6400; NAS 1.15:104526) Avail: NTIS HC/MF A02 CSCL 10A

Impedances were measured on several Li/SO2 cells retrieved from the Long Duration Exposure Facility (LDEF) satellite. These cells were used to power instruments and recorders and had all been partially or fully discharged. Impedances were also measured on several cells that were stored in cold storage since manufacture. Unfortunately, none of the cells stored terrestrially had undergone any discharge, whereas all of the cells on the satellite were at least partially discharged early in the mission and then remained on orbit for about 5 years further. It has been observed by others that storage of an Li/SO2 cell after partial discharge, increases the resistance and thickness of the passive film on the Li electrode, as indicated by an increase in the time for recovery of voltage when a load is applied (voltage lag), or in some cases by an inability of a cell to sustain a normal current after such storage. Since the cells stored terrestrially were not discharged in the same manner as the LDEF cells, a direct comparison cannot be made. Thus, the effects of the space environment cannot be separated from the effects of storage after partial discharge. It is believed that the increases in impedance in the LDEF cells are largely due to the storage upon partial discharge rather than the effects of the space environment. Author

N92-13485 Department of the Navy, Washington, DC.
EXTERNALLY HEATED THERMAL BATTERY Patent
Louis Pracchia, inventor (to Navy), Ronald F. Vetter, inventor (to Navy), and Darwin Rosenlof, inventor (to Navy) 9 Apr. 1991 6 p Filed 24 Aug. 1989
(AD-D015009; US-Patent-5,006,429; US-Patent-Appl-SN-401200; US-Patent-Class-429-112) Avail: US Patent and Trademark Office CSCL 10/3

A thermal battery activated by external heat comprising an anode (e.g., composed of a lithium-aluminum alloy), a cathode (e.g., composed of iron disulfide), and an electrolyte (e.g., a lithium chloride-potassium chloride eutectic) with the electrolyte inactive at ambient temperature but activated by melting at a predetermined temperature when exposed to external heating is presented. The battery can be used as a sensor or to ignite pyrotechnic and power electronic devices in a system for reducing the hazard of ordnance exposed to detrimental heating. A particular application is the use of the battery to activate a squib to function in conjunction with one or more other components to vent an ordnance case in order to prevent its explosion in a fire. GRA

N92-13486# Sandia National Labs., Albuquerque, NM.
NUMERICAL SIMULATION OF MAGMA ENERGY EXTRACTION
C. E. Hickox 1991 20 p Presented at the US/Japan Joint Seminar on Heat Transfer, Oiso, Japan, 21-25 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE91-019063; SAND-91-1694C; CONF-9110214-1) Avail: NTIS HC/MF A03

The Magma Energy Program is a speculative endeavor regarding practical utility of electrical power production from the thermal energy which resides in magma. The systematic investigation has identified a number of research areas which have application to the utilization of magma energy and to the field of geothermal energy. Eight topics were identified which involve thermal processes and which are areas for the application of the techniques of numerical simulation. These areas are (1) two-phase flow of the working fluid in the wellbore, (2) thermodynamic cycles for the production of electrical power, (3) optimization of the entire system, (4) solidification and fracturing of the magma caused by the energy extraction process, (5) heat transfer and fluid flow within an open, direct-contact, heat-exchanger, (6) thermal convection in the overlying geothermal region, (7) thermal convection within the magma body, and (8) induced natural convection near the thermal energy extraction device. Modeling issues have been identified which will require systematic investigation in order to develop the most appropriate strategies for numerical simulation. It appears that numerical simulations will be of ever increasing importance to the study of geothermal processes as the size and complexity of the systems of interest increase. It is anticipated that, in the future, greater emphasis will be placed on the numerical simulation of large-scale, three-dimensional, transient, mixed convection in viscous flows and porous media. Increased computational capabilities, e.g.; massively parallel computers, will allow for the detailed study of specific processes in fractured media, non-Darcy effects in porous media, and non-Newtonian effects. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-13487# Oak Ridge National Lab., TN.
DESCRIPTIONS OF RESEARCH SITES IN THE INTEGRATED FOREST STUDY ON EFFECTS OF ATMOSPHERIC DEPOSITION
E. A. Bondiette, ed. Mar. 1990 128 p
(Contract DE-AC05-84OR-21400)
(DE90-012033; ORNL/TM-11149; ESDP-3279) Avail: NTIS HC/MF A07

This site descriptions report documents the site characteristics and site-specific measurement approaches of participating sites in the Integrated Forest Study on Effects of Atmospheric Deposition (IFS), a multiyear integrated research effort designed to improve our understanding of how chemicals which are deposited from the atmosphere influence the mineral nutrient cycles in forests. The research has been performed at a series of forested sites in the U.S., Canada, and Norway. DOE

N92-13488# Oak Ridge National Lab., TN. Carbon Dioxide Information Analysis Center.
A PLAN FOR INTERMODEL COMPARISON OF ATMOSPHERIC CO2 PROJECTIONS WITH UNCERTAINTY ANALYSIS
A. W. King and M. J. Sale Jun. 1990 43 p
(Contract DE-AC05-84OR-21400)
(DE90-011298; ORNL/CDIAC-32) Avail: NTIS HC/MF A03

This document is a plan for an intermodel comparison of atmospheric CO2 projections that includes uncertainty analysis of the global carbon cycle models used to make those projections. The plan includes a procedure for the documentation, support, and archiving of global carbon cycle models within the Carbon Dioxide Information Analysis Center (CDIAC) at Oak Ridge National Laboratory (ORNL). The best global carbon cycle model is not one of the objectives. Rather, the principal goals are to develop a picture of where global carbon cycle modeling stands, at present, in the projection of future atmospheric CO2 concentrations and to acquire information that can be used to determine research needs for CO2 modeling. The plan involves three phases: model implementation-- the acquisition and computer implementation of the global carbon cycle models; model analysis-- sensitivity and uncertainty analysis of each model; and synthesis-- an intermodel comparison of the projections of future atmospheric CO2 concentrations and characterization of across-model patterns in the atmospheric projections and associated uncertainties. DOE

N92-13489# Energy and Environmental Research Corp., Irvine, CA.

AN INVESTIGATION TO DEFINE THE PHYSICAL/CHEMICAL CONSTRAINTS WHICH LIMIT NO(x) EMISSION REDUCTION ACHIEVABLE BY REBURNING

S. L. Chen, L. Ho, J. A. Cole, and W. R. Seeker Oct. 1989 144 p

(Contract DE-AC22-86PC-91025)

(DE90-011457; DOE/PC-91025/T2) Avail: NTIS HC/MF A07

This report describes the efforts performed on a program designed to investigate the constraints of the reburning process for advanced NO(x) control. The status and history of reburning technology will be reviewed first. This will be followed by descriptions of the program scope, the experimental approach, the experimental results, and the conclusions. Finally, the kinetic mechanisms of reburning will be presented as appendix. DOE

N92-13490# Lawrence Livermore National Lab., CA.

USER'S GUIDE TO THE MATHEW/ADPIC (MASS-ADJUSTED THREE-DIMENSIONAL WIND/ATMOSPHERIC DIFFUSION PARTICLE-IN-CELL) MODELS

D. J. Rodriguez, G. D. Greenly, P. M. Gresho, R. Lange, B. S. Lawver, L. A. Lawson, and H. Walker 16 Apr. 1990 178 p

(Contract W-7405-eng-48)

(DE90-013047; UCRL-MA-103581) Avail: NTIS HC/MF A09

This user's guide provides both an operational and theoretical summary of the MATHEW/ADPIC transport and diffusion models and supplemental codes needed to execute these models. The acronym, MATHEW, comes from Mass-Ajusted THrEe-dimensional Wind field. ADPIC stands for Atmospheric Diffusion Particle-In-Cell model. These models calculate air concentration and ground deposition on a regional scale (up to 200 km) from continuous or instantaneous point sources. MATHEW is a three-dimensional meteorological data-adjustment model which supplies ADPIC with mean wind fields that are mass-consistent and representative of the available meteorological measurements. The bottom boundary in this model is determined by grid cell estimates of the actual topographic features of a given site and its environs, which can play a very important role in defining or modeling regional-scale patterns. ADPIC is a three-dimensional, particle-in-cell transport and diffusion code capable of calculating the time-dependent dispersion of inert or radioactive air pollutants. An overview of MATHEW/ADPIC and the support routines is included. A complete technical formulation of each code is included along with a user's guide to each code. DOE

N92-13491# Los Alamos National Lab., NM.

ATMOSPHERIC MODELING IN COMPLEX TERRAIN

M. D. Williams and G. E. Streit May 1990 95 p Presented at the Workshop on Modeling and Simulation of Atmospheric Dynamics and Pollution, Mexico City (Mexico), 11-20 Mar. 1990

(Contract W-7405-eng-36)

(DE90-013165; LA-UR-90-2060; CONF-9003179-1) Avail: NTIS HC/MF A05

Los Alamos investigators have developed several models which are relevant to modeling Mexico City air quality. The collection of models includes: meteorological models, dispersion models, air chemistry models, and visibility models. The models have been applied in several different contexts. They have been developed primarily to address the complexities posed by complex terrain. HOTMAC is the meteorological model which requires terrain and limited meteorological information. HOTMAC incorporates a relatively complete description of atmospheric physics to give good descriptions of the wind, temperature, and turbulence fields. RAPTAD is a dispersion code which uses random particle transport and kernel representations to efficiently provide accurate pollutant concentration fields. RAPTAD provides a much better description of tracer dispersion than do Gaussian puff models which fail to properly represent the effects of the wind profile near the surface. ATMOS and LAVM treat photochemistry and visibility respectively. ATMOS has been used to describe wintertime chemistry of the Denver brown cloud. Its description provided reasonable agreement with measurements for the high altitude of Denver. LAVM can provide both numerical indices or pictoral representations of visibility effects of pollutants. DOE

N92-13492# Department of Energy, Washington, DC. Office of Environmental Analysis.

GLOBAL CLIMATE TRENDS AND GREENHOUSE GAS DATA: FEDERAL ACTIVITIES IN DATA COLLECTION, ARCHIVING, AND DISSEMINATION

Jun. 1990 401 p

(DE90-013545; DOE/PE-0094P) Avail: NTIS HC/MF A18

This report examines current and emerging efforts of the U.S. Government to collect, manage, and disseminate data on the emissions of greenhouse gases, their atmospheric concentrations, and trends in the earth's climate. It reviews how data are used to estimate and project emissions, to infer climate trends, and to support assessment and policy analysis functions, as well as its use in scientific research. It examines coordination of Federal data activities among agencies. In addition to data needed for scientific research and identification of trends, this report considers the special data and information needs of government and the public for assessment and policy analysis purposes. The report concludes with recommendations for strengthening data collection and management efforts in light of anticipated large increases in collection and demand for such data over the next decade. DOE

N92-13493# Kansas State Univ., Manhattan. Dept. of Agronomy.

RANGELAND-PLANT RESPONSE TO ELEVATED CO2

M. B. Kirkham, E. T. Kanemasu, G. W. Harbers, D. W. Reed, Hong He, R. D. Theisen, T. P. Bolger, D. E. Goodrum, L. K. Ballou, and D. J. Lawlor et al 1990 90 p

(Contract DE-FG02-84ER-60253)

(DE90-013693; DOE/ER-60253/T3) Avail: NTIS HC/MF A05

No studies have been published concerning the effect of elevated levels of atmospheric carbon dioxide (CO2) on the growth of range plants in a natural habitat. Therefore, the objective of this research was to determine the response of plants on a native grassland to different CO2 concentrations and soil-moisture conditions. The study was carried out during the 1989 growing season on a rangeland in Manhattan, Kansas. Sixteen large, closed-top, plastic chambers were constructed and placed on the experimental site. Half of the chambers received the ambient level of CO2 and half of the chambers received two-times the ambient concentration. Half of the chambers were irrigated to maintain well-watered conditions and half of the chambers were drought-stressed. There were four replications. During the season, measurements of soil-water content were taken, as well as measurements of transpiration, stomatal resistance photosynthesis, and CO2 concentration in the intercellular spaces of the leaves of big bluestem. At harvest on 31 October 1989, plants were divided into four groups: warm-season grasses; cool-season grasses; sedges; and forbs. DOE

N92-13494# Office of Technology Assessment, Washington, DC.
BIOTECHNOLOGY IN A GLOBAL ECONOMY. VOLUME 2, PART 1: CONTRACTOR DOCUMENTS
Jun. 1991 259 p
(PB91-212068) Avail: NTIS HC/MF A12 CSCL 13B

Volume 2, part 1 of this report is comprised of various papers relating to the biotechnology industry and its level of development in various countries. Major topics discussed include the current status of the industry in these countries, financing sources, future strategies, special projects being pursued, and technology transfer. GRA

N92-13495# Office of Technology Assessment, Washington, DC.
BIOTECHNOLOGY IN A GLOBAL ECONOMY. VOLUME 2, PART 2: CONTRACTOR DOCUMENTS
Jun. 1991 259 p
(PB91-212076) Avail: NTIS HC/MF A12 CSCL 13B

Volume 2, part 2 of this report is comprised of four separate reports addressing various topics related to the biotechnology industry. Individual titles include the following: Biotechnology developments in Asia -- a financial perspective; Commercial biotechnology in Japan; Environmental biotechnology -- commercial prospects; and International biotechnology patenting. GRA

N92-13496# National Inst. of Standards and Technology, Gaithersburg, MD. Building and Fire Research Lab.
APPLICATIONS OF THE GENERALIZED GLOBAL EQUIVALANCE RATIO MODEL (GGERM) FOR PREDICTING THE GENERATION RATE AND DISTRIBUTION OF PRODUCTS OF COMBUSTION IN TWO-LAYER FIRE ENVIRONMENTS: METHANE AND HEXANES
Leonard Y. Cooper Jun. 1991 78 p
(PB91-216689; NISTIR-4590) Avail: NTIS HC/MF A05 CSCL 13B

The Generalized Global Equivalence Ratio Model (GGERM) was developed to predict the generation rates of oxygen, fuel, and other products of combustion in rooms containing fires. The GGERM extends to general transient conditions the global equivalence ratio model established during times of steady-state in experimental studies involving two-layer compartment fires. The GGERM is used to predict upper layer mass fractions of products of combustion (fuel, oxygen, CO, and others) in these two-layer fire experiments, but during times of transient response. All predicted results are found to be plausible and, where transient data are available, predicted and measured results compare favorable. However, available data are limited and additional validation of the GGERM under more varied fire conditions is required before it can be used with confidence in two-layer zone-type compartment fire models. GRA

N92-13497*# New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
ORGANIC ACIDS AND SELECTED NITROGEN SPECIES FOR ABLE-3 Final Technical Report, 1 Dec. 1988 - 30 Nov. 1991
Robert W. Talbot Nov. 1991 32 p
(Grant NAG1-936)
(NASA-CR-189017; NAS 1.26:189017) Avail: NTIS HC/MF A03 CSCL 13B

The NASA Global Tropospheric Experiment (GTE) executed airborne science missions aboard the NASA Wallops Electra (NA429) in the North American high latitude (greater than 45 deg North) atmosphere during Jul. to Aug. 1988 and Jul. to Aug. 1990. These missions were part of GTE's Atmospheric Boundary Layer Experiment (ABLE). The 1988 mission , ABLE-3A, examined the ecosystems of Alaska as a source and/or sink for important tropospheric gases and particles, and gained new information on the chemical composition of the Arctic atmosphere during the summertime. During 1990 the second high latitude mission, ABLE-3B, focused on the Hudson Bay Lowland and Labrador regions of Canada. Both of these missions provided benchmark data sets on atmosphere biosphere exchange and atmospheric chemistry over largely uninhabited regions of North America. In support of the GTE/ABLE-3A and -3B field missions, the University of New Hampshire flew instrumentation aboard the Wallops Electra research aircraft to provide measurements of the trace gases nitric (HNO3), formic (HCOOH), and acetic (CH3COOH) acid. In addition, measurements were conducted to determine the major water soluble ionic composition of the atmospheric aerosol. For ABLE-3B, groundbased measurements of the acidic trace gases were also performed from the NASA micrometerological tower situated at Schefferville, Laborador. These measurements were aimed at assessing dry deposition of acidic gases to the taiga ecosystem in the Laborador region of Canada. Author

N92-13498# Army Inst. for Water Resources, Fort Belvoir, VA.
ENVIRONMENTAL ENDS AND ENGINEERING MEANS: BECOMING ENVIRONMENTAL ENGINEERS FOR THE NATION AND THE WORLD Final Report
Jerome D. Priscoli 1 May 1991 16 p
(AD-A240798; IWR-WP-90-ADR-WP-4) Avail: NTIS HC/MF A03 CSCL 13/2

Humanity is moving toward a new consciousness of Earth and nature. The consciousness has been stimulated by often confusing and bitter debates among the engineering and environmental communities. Unfortunately, such experience has left a stronger impression of adversarial rather than cooperative relationships. This impression is and will change. At the bottom line, the public engineering community share interests with the environmental community that are far deeper than the often held adversarial positions they frequently defend. Public service engineers, the environmental community and the public(s), need credible governmental agents as instruments to achieve environmental goals. If government is viewed as incompetent, inefficient or untrustworthy, both the environmental community and the public engineers will suffer. In short, the environmental community and the engineers need one another. To reach environmental ends, the world needs engineering means. To employ engineering means requires justification in terms of environmental ends. GRA

N92-13499# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Armstrong Lab.
ENVIRONMENTAL SAMPLING SURVEY, THULE AB, GREENLAND Final Report, 13 - 22 Aug. 1990
Nancy S. Miller Aug. 1991 146 p
(AD-A241506; AL-TR-1991-0076) Avail: NTIS HC/MF A07 CSCL 24/3

An environmental sampling survey was performed at Thule Air Base, Greenland. The scope of the survey was to sample, analyze, and determine the appropriate disposition of approximately 1,000 drums containing unknown materials. Approximately 4,000 drums were marked with labels stating that the drums contain anything from poison to varnish. However, upon visual inspection of the contents of several drums, the material was determined to be tar. Drums of used and unused materials were identified to be sampled. Many of the drums were marked waste oil; however the drums appeared to have never been opened. Other drums appeared to contain new material. The drums appear to have been rejected by the shops because of physical damage (i.e., dented). Each drum was either sampled individually or, when feasible, composited with another drum. Each drum was numbered. The drum color, waste label, new material label, and generating activity were noted during the presurvey. This information was used to develop a waste analysis plan. Once the actual survey began and drums were opened, it became apparent the original sampling strategy would have to be altered (i.e., some drums did not contain what we hoped they would). The report contains the revised waste analysis plan. GRA

N92-13500# Lawrence Livermore National Lab., CA.
A CONDENSED GLOBAL PHOTOCHEMICAL MECHANISM FOR TWO-DIMENSIONAL ATMOSPHERIC MODELS
J. Tamaresis, D. E. Kinnison, and D. J. Wuebbles 1991 24 p
(Contract W-7405-eng-48)
(DE92-000101; UCRL-ID-108377) Avail: NTIS HC/MF A03

A condensed chemical mechanism that represents the reactions of organic compounds in the atmosphere is developed and tested using a one-dimensional model. Due to the differences between the full and condensed mechanisms, the reduced version cannot be considered an accurate predictor of globally important trace species concentrations. The condensed mechanism must be improved before it can be used with confidence in two-dimensional models. The appendix contains both full and reduced mechanisms of photolysis and thermal reactions as well as species profile comparisons. DOE

N92-13084# Joint Publications Research Service, Arlington, VA.
SATALLITE SYSTEMS FOR GLOBAL ECOLOGICAL MONITORING
B. Konovalov *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 33-34 Transl. into ENGLISH from Izvestiya, Moscow (USSR), 3 Jan. 1990 p 3 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

N92-13623*# Harvard Univ., Cambridge, MA.
NEW EVIDENCE FOR A DRAMATIC RISE IN ATMOSPHERE OXYGEN CA. 1,900 M.Y. AGO Abstract Only
H. D. Holland and A. W. Macfarlane *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 56 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 13B

N92-13624*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BIOSPHERIC-ATMOSPHERIC COUPLING ON THE EARLY EARTH
J. S. Levine *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 57 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 13B

N92-13856*# University of Western Carolina, Cullowhee, NC. Dept. of Mathematics and Computer Science.
ANALYSIS OF PRESSURE-BROADENED OZONE SPECTRA IN THE 3 MICRON REGION
Eleanor S. Prochaska *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 186-189 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 13B

N92-13863*# Missouri Univ., Columbia. Nuclear Engineering Program.
CONDENSATIONAL GROWTH AND TRACE SPECIES SCAVENGING IN STRATOSPHERIC SULFURIC ACID/WATER AEROSOL DROPLETS
Robert V. Tompson, Jr. *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 215-220 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 13B

N92-13866*# Delaware Univ., Newark. Dept. of Physics and Astronomy.
LINE NARROWING OF AgGaSe2 OPTICAL PARAMETRIC OSCILLATOR BY INJECTION SEEDING
George H. Watson, Norman Barnes, and Keith Murray *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 229-231 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-13501 Texas A&M Univ., College Station.
TRANSIENT SYNOPTIC FORCING OF TROPICAL PLUMES IN A BAROTROPIC MODEL WITH A REALISTIC BASIC STATE Ph.D. Thesis
Keith Gordon Blackwell 1990 285 p
Avail: Univ. Microfilms Order No. DA9118189

Tropical plumes are synoptic scale systems in the tropical upper troposphere which frequent the central and eastern North Pacific. They occur to the east of regions of anomalous atmospheric subsidence. A global divergent barotropic model, with known divergent forcing and a specified realistic basic state for January, is used to investigate the ability of transient convergence to initiate tropical plumes. Development of tropical plumes in the model is highly sensitive to the location of transient convergent forcing within the basic state; tropical plumes develop when transient forcing is centered several degrees equatorward of a large absolute vorticity gradient. Tropical plumes weaken if the forcing is removed. The most intense and long-lived tropical plume forms within a simulated surge in the Walker circulation. Appropriately placed transient convergent forcing triggers tropical plume formation immediately to the east. Once convergence is forced (a baroclinic mechanism), the model demonstrates that tropical plume development is predominantly barotropic. The 5 simulated tropical plumes in this research depict flow patterns and features closely resembling those observed in nature. Significant features include: (1) a subtropical trough exhibiting a pronounced southwest/northwest tilt with latitude; (2) divergence dipole extrema exceeding 3 x 10(exp -6) s(exp -1) within the tropical plume source region; (3) a 3000 km tropical wave within the divergence field; (4) cross-contour flow inducing an intense meridional subtropical jet exceeding 60 m s(exp -1) between 15 deg N and 20 deg N; (5) poleward wind accelerations exceeding 30 m s(exp -1) equatorward of 20 deg N; and, (6) strong equatorial westerlies. When transient forcing is not appropriately located, either no response is observed or hybrid plumes develop. Hybrid plumes display similar characteristics to tropical plumes, but fail to meet an objective plume definition.
Dissert. Abstr.

N92-13502 California Univ., Davis.
APPLICATION OF THE MACCORMACK SCHEME TO ATMOSPHERIC NONHYDROSTATIC MODELS Ph.D. Thesis
Luis Rodriguez-Mendez-Nunez 1990 273 p
Avail: Univ. Microfilms Order No. DA9118404

The MacCormack scheme, a finite differences technique widely used in aerospace simulations, is adapted for atmospheric nonhydrostatic models. This two step algorithm contains a small amount of implicit numerical diffusion that makes it numerically stable without having to use any kind of explicit filtering. It uses a non-staggered grid, whereby open lateral and top boundary conditions are straightforward to implement with no reflection at the boundaries observed. A detailed comparison, in 1-D and 2-D, with the leapfrog scheme is presented. The linear and nonlinear advection equations and the Euler equations were solved in 1-D space for a variety of conditions at different Courant numbers. In the 2-D case, the development of a buoyant bubble was simulated. The model is fully compressible, i.e., uses the full Navier-Stokes equation without any approximation. The results with the 1-D linear equation showed that the MacCormack scheme has much less numerical diffusion than the linear upstream scheme, more than the Smolarkievicwz scheme and about the same as the leapfrog scheme. It has much less numerical dispersion than the leapfrog scheme, slightly more than the Smolarkievicwz scheme and much more than the upstream scheme. The intensity of the undesired properties increases with decreasing Courant number. The results with the 1-D nonlinear advection equation showed that the MacCormack scheme has much less numerical dispersion than

the leapfrog scheme. In the 2-D simulation, the MacCormack scheme without explicit numerical filtering produced reasonable solutions. If very steep gradients are present in the flow the solution obtained with the MacCormack scheme without any explicit filtering produced numerical oscillations that locally decreased the accuracy of the solution but did not make the scheme numerically unstable. Dissert. Abstr.

N92-13503 Iowa Univ., Iowa City.
THE INNER EDGE OF THE PLASMA SHEET, REGION-2 CURRENTS, AND ELECTRON PRECIPITATION: PLASMA OBSERVATIONS FROM ISEE 1 Ph.D. Thesis
William Russell Paterson 1990 284 p
Avail: Univ. Microfilms Order No. DA9122099

On 17 April, 29 April, and 4 June of 1978 the International Sun Earth Explorer (ISEE) 1 spacecraft encountered the inner edge of the plasma sheet on the dusk side of Earth at radial distances of 6 to 9 R(sub E). Measurements obtained with a plasma analyzer aboard this spacecraft are examined in an effort to determine the source of Region-2 Birkeland currents. Near the inner edge it is found that the distributions of both electrons and positive ions have low-energy field-aligned components that apparently originate at low altitudes. In two cases, it is also found that the low-energy electrons carry a current that is consistent in direction and magnitude with Region-2 currents observed at low altitude. Positive ions with energies per charge less than or approximately = to 1 kV also stream along the field and sometimes provide a current that is comparable in magnitude but opposite in direction to the electron current. The low-energy electrons are counterstreaming and appear to be backscattered secondaries produced by precipitation of keV plasma sheet electrons into the atmosphere. An analysis of electron distributions indicates that the inner edge is a drift boundary separating open and closed flow trajectories. However, shielding there is found to be more localized than the shielding assumed in standard convection models. This shielding may be provided by the low-energy field-aligned plasmas. It is also found that the electron distributions at the inner edge are strongly modified, apparently by pitch-angle diffusion which drives keV electrons into the loss cone and scatters secondary electrons out of the source cone, and modification of the distributions by pitch-angle diffusion may also play a role in producing the field-aligned currents. Thus, it is found that precipitation and pitch-angle diffusion play important roles in determining the structure of the inner magnetosphere and may serve to couple apparently diverse phenomena such as diffuse aurora, Region-2 currents, and formation of the inner edge.
Dissert. Abstr.

N92-13504*# Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
THE ROLE OF GLOBAL CLOUD CLIMATOLOGIES IN VALIDATING NUMERICAL MODELS Semiannual Report, 1 Apr. - 30 Sep. 1991
Harshvardhan 1991 18 p Prepared for presentation at the ECMWF/GEWEX Workshop on the Hydrology and Surface Radiation in Atmospheric Models, Reading, England, 28 Oct. - 1 Nov. 1991
(Grant NAG5-1125)
(NASA-CR-188923; NAS 1.26:188923) Avail: NTIS HC/MF A03 CSCL 04A

The net upward longwave surface radiation is exceedingly difficult to measure from space. A hybrid method using General Circulation Model (GCM) simulations and satellite data from the Earth Radiation Budget Experiment (ERBE) and the International Satellite Cloud Climatology Project (ISCCP) was used to produce global maps of this quantity over oceanic areas. An advantage of this technique is that no independent knowledge or assumptions regarding cloud cover for a particular month are required. The only information required is a relationship between the cloud radiation forcing (CRF) at the top of the atmosphere and that at the surface, which is obtained from the GCM simulation. A flow diagram of the technique and results are given. Author

N92-13505 Illinois Univ. at Urbana-Champaign, Savoy.
IONOSPHERIC IMAGING USING COMPUTERIZED TOMOGRAPHY Ph.D. Thesis
Jeffrey Robert Austen 1991 185 p
Avail: Univ. Microfilms Order No. DA9124379

Computerized tomography (CT) techniques can be used to produce a 2-D image of the electron density in the ionosphere. The necessary data are transionospheric satellite beacon total electron content (TEC) data recorded simultaneously at multiple ground stations. The ionospheric imaging case presents a difficult problem due to large amounts of missing data. This is a consequence of the locations of the transmitter (in orbit) and receivers (ground based) and causes the reconstruction algorithm to fail to correctly reconstruct the background density profile. Despite this limitation, a method has been developed which successfully reconstructs the irregularities and variations in the profile. A computer program simulates the data collection and image reconstruction process. A new algorithm, which is a modification of the discrete backprojection algorithm, is developed for use with nonuniform sampling geometries. It produces good quality results in cases where the unmodified algorithm fails to produce a usable result. Simulations are performed on both test images and realistic ionospheric models in order to demonstrate the capabilities and limitations of this technique. Dissert. Abstr.

N92-13506*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
THE OHIO STATE 1991 GEOPOTENTIAL AND SEA SURFACE TOPOGRAPHY HARMONIC COEFFICIENT MODELS
Richard H. Rapp, Yan Ming Wang, and Nikolaos K. Pavlis Aug. 1991 100 p
(Contract NAG5-781; JPL-958121)
(NASA-CR-188628; NAS 1.26:188628; OSU-410) Avail: NTIS HC/MF A05 CSCL 08E

The computation is described of a geopotential model to deg 360, a sea surface topography model to deg 10/15, and adjusted Geosat orbits for the first year of the exact repeat mission (ERM). This study started from the GEM-T2 potential coefficient model and it's error covariance matrix and Geosat orbits (for 22 ERMs) computed by Haines et al. using the GEM-T2 model. The first step followed the general procedures which use a radial orbit error theory originally developed by English. The Geosat data was processed to find corrections to the a priori geopotential model, corrections to a radial orbit error model for 76 Geosat arcs, and coefficients of a harmonic representation of the sea surface topography. The second stage of the analysis took place by doing a combination of the GEM-T2 coefficients with 30 deg gravity data derived from surface gravity data and anomalies obtained from altimeter data. The analysis has shown how a high degree spherical harmonic model can be determined combining the best aspects of two different analysis techniques. The error analysis was described that has led to the accuracy estimates for all the coefficients to deg 360. Significant work is needed to improve the modeling effort. Author

N92-13507*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AN INITIAL ANALYSIS OF THE DATA FROM THE POLAR ORBITING GEOPHYSICAL (POGS) SATELLITE
R. A. Langel, T. J. Sabaka, and R. T. Baldwin (ST Systems Corp., Lanham, MD.) Washington Nov. 1991 23 p Sponsored in part by Phillips Lab.
(NASA-TM-104551; NAS 1.15:104551; Rept-92E00297) Avail: NTIS HC/MF A03 CSCL 08G

The Polar Orbiting Geophysical Satellite (POGS) was launched in 1990 to measure the geomagnetic field. POGS data from selected magnetically quiet days was chosen, quality checked and deleted where thought to be erroneous. A time and position correction was applied. The resulting data was fit to a degree 13 spherical harmonic model. Evaluation of the quality of the data indicates that it is sufficient for definition of the low degree (approximately less than 8) portion of the geomagnetic field. Further

correction of the data time and position may improve this quality.
Author

N92-13508*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
THE INTERPRETATION OF CRUSTAL DYNAMICS DATA IN TERMS OF PLATE MOTIONS AND REGIONAL DEFORMATION NEAR PLATE BOUNDARIES Semiannual Status Report No. 10, 22 Mar. - 21 Sep. 1991
Sean C. Soloman 1991 50 p
(Grant NAG5-814)
(NASA-CR-185844; NAS 1.26:185844) Avail: NTIS HC/MF A03 CSCL 08G

The focus was in two broad areas during the most recent 6-month period: (1) the nature and dynamics of time dependent deformation and stress along major seismic zones; and (2) the nature of long-wavelength oceanic geoid anomalies in terms of lateral variations in upper mantle temperature and composition. The principle findings are described in the accompanying appendices. Author

N92-13509# Alaska Univ., Fairbanks. Geophysical Inst.
DEVELOPMENT OF A NUMERICAL SCHEME TO PREDICT GEOMAGNETIC STORMS AFTER INTENSE SOLAR EVENTS AND GEOMAGNETIC ACTIVITY 27 DAYS IN ADVANCE Final Report, 6 Aug. 1986 - 16 Nov. 1990
S.-I. Akasofu and Li-Her Lee Feb. 1991 63 p
(Contract F19628-86-K-0030)
(AD-A240802; PL-TR-91-2050) Avail: NTIS HC/MF A04 CSCL 08/4

The modern geomagnetic storm prediction scheme should be based on a numerical simulation method, rather than on a statistical result. Furthermore, the scheme should be able to predict the geomagnetic storm indices, such as the Dst and AE indices, as a function of time. By recognizing that geomagnetic storms are powered by the solar wind-magnetosphere generator and that its power is given in terms of the solar wind speed, the interplanetary magnetic field (IMF) magnitude and polar angle, we have made a major advance in predicting both flare-induced storms and recurrent storms. Furthermore, it is demonstrated that the prediction scheme can be calibrated using the interplanetary scintillation (IPS) observation, when the solar disturbance advances about half-way to the earth. It is shown, however, that we are still far from a reliable prediction scheme. The prediction of the IMF polar angle requires future advance in understanding characteristics of magnetic clouds. GRA

N92-13510# Colorado School of Mines, Golden. Center for Wave Phenomena.
VELOCITY ANALYSIS BY INVERSION Technical Report, 1 Oct. 1990 - 30 Sep. 1991
Zhenyue Liu and Norman Bleistein 20 May 1991 19 p
(Contract N00014-91-J-1267)
(AD-A241003) Avail: NTIS HC/MF A03 CSCL 08/11

In conventional inversion methods, imaging structure inside the Earth requires reasonable background velocities. In this paper, velocity analysis and structural imaging are done at the same time. The medium is assumed to consist of constant-velocity layers separated by arbitrary, smooth interfaces. The objective of the inversion is to determine layer velocities and locations of the interfaces. The velocity analysis is based on the principles that the images will be distorted when erroneous velocities are used. In particular, the difference between the depths computed by inversions from different experiments can be a measure of the error in velocity. The formulas of sensitivity to velocity error are derived for some special cases. Some computer implementations for both synthetic data and experimental data are done. GRA

N92-13511# Lowell Univ., MA. Center for Atmospheric Research.
HF/VHF RADIOWAVE TECHNIQUES FOR INVESTIGATING HIGH LATITUDE IONOSPHERIC DISTURBANCES Final Report, Sep. 1987 - Dec. 1990
Jens Ostergaard, Jay A. Weitzen, Eric Li, D. M. Haines, and Gary S. Sales Apr. 1991 35 p
(Contract F19628-88-K-0004)
(AD-A241024; ULFR-471/CAR; PL-TR-91-2093) Avail: NTIS HC/MF A03 CSCL 20/14

The object of this contract was to develop a unified model for radio wave propagation in the 2-147 MHz band at high latitudes, especially during disturbances. This particularly included the analysis and measurement of the frequency dependence during polar cap absorption events and assessment of the effects of artificially induced perturbations on radio waves within this band. This project concentrated on single hop HF ionospheric propagation in the 2-30 MHz band and VHF meteor scatter in the 45-147 MHz band. GRA

N92-13512# Naval Postgraduate School, Monterey, CA.
AIRCRAFT OBSERVATIONS OF THE ATMOSPHERIC BOUNDARY LAYER IN THE VICINITY OF THE MARGINAL ICE ZONE UNDER CONDITIONS OF FLOW PARALLEL TO THE ICE EDGE M.S. Thesis
Teresa M. Gobel Sep. 1990 55 p
(AD-A241072) Avail: NTIS HC/MF A04 CSCL 04/2

This paper describes aircraft observations made with the NOAA P-3 research aircraft on 24 March 1989. The measurement region was over the marginal ice zone, southeast of Spitzbergen, between 74 to 76 degs N and 19 to 27 degs E. Above the atmospheric boundary layer, the geostrophic wind was 12 m/s at approximately 15 deg off-ice. A well mixed layer extended along the entire 200 km flight path which was perpendicular to and centered over the ice edge. There was a stratocumulus layer over the ocean which decreased in thickness towards the ice. The associated inversion, which coincided with the cloud layer top, continued to decrease in height over the ice. This caused a strong thermal wind effect within the atmospheric boundary layer. The near-surface geostrophic wind decreased from approximately 12 m/s over the ocean to 5 m/s over the ice due to the horizontal temperature gradient and sloping inversion. GRA

N92-13513# University Coll. of Wales, Aberystwyth. Dept. of Physics.
TOTAL ELECTRON CONTENT AND SCINTILLATION IN THE VICINITY OF THE MAIN IONOSPHERIC THROUGH OVER NORTHERN EUROPE Final Report, Jul. 1990 - 30 Jun. 1991
L. Kersley and I. K. Walker 30 Jun. 1991 28 p
(Grant AF-AFOSR-0378-87)
(AD-A241205; AFOSR-91-08TR) Avail: NTIS HC/MF A03 CSCL 09/1

A receiving system for NNSS satellites located at Lerwick (60.1 N, 1.2 W) has been used to make differential carrier phase measurements in the vicinity of the main ionospheric trough. The observations have been calibrated to obtain absolute total electron content using measurements from a co-located GPS receiver for two months near solar maximum. Mapping techniques, developed to study the changes in night-time total electron content as a function of both latitude and time, are described. Examples are given of characteristic trough behavior for different levels of geomagnetic activity. A new feature of the work is the limited extent of the poleward wall of the trough for moderate geomagnetic conditions. The mapping techniques can also be applied to measurements of radio-wave scintillation allowing comparison between small-scale irregularity behavior and the larger-scale changes in total electron content. GRA

N92-13514# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
NUMERICAL MODELING OF MIDDLE AND HIGH LEVEL CLOUDS WITH THE COLORADO STATE UNIVERSITY REGIONAL ATMOSPHERIC MODELING SYSTEM (RAMS) Final Technical Report, 1 Mar. 1989 - 1 Jun. 1991
William R. Cotton, Piotr J. Flatau, and Graeme L. Stephens 26 Aug. 1991 152 p
(Grant AF-AFOSR-0143-88; AF Proj. 2310)

(AD-A241460; AFOSR-91-0793TR) Avail: NTIS HC/MF A08 CSCL 04/1

Research supported on this grant has focused on cirrus clouds. The includes the analysis of data collected during the First ISCCP Regional Experiment (FIRE) cirrus experiment, refinement of the microphysics of the Regional Atmospheric Modeling System (RAMS) for cirrus cloud simulations, development of cirrus radiation theory and parameterizations, and performing mesoscale simulations of cirrus clouds. The simulations demonstrated that RAMS has the ability to simulate many observed features of cirrus clouds including multiple layering, cirrus generation zones, and the growth and dissipation of cirrus for specific cases. The results suggest that RAMS may be suitable for numerical forecasting of cirrus clouds. GRA

N92-13515# Aerospace Corp., El Segundo, CA. Technology Operations.

CO ENERGY TRANSFER PROCESSES IN THE MESOSPHERE AND THERMOSPHERE Technical Operating Report

Valerie I. Lang 15 Aug. 1991 48 p

(Contract F04701-88-C-0089)

(AD-A241656; TOR-0091(6078)-1) Avail: NTIS HC/MF A03 CSCL 04/1

A critical review of rate constants for CO collisional relaxation processes and spontaneous emission processes is presented. Collision partners and vibrational excitation levels are limited to those relevant to the atmosphere between 50 and 300 km under nonlocal thermodynamic equilibrium conditions. The rates discussed are important parameters for modeling atmospheric infrared radiance. Background atmospheric radiation is an important consideration in aerospace sensor design. Accurate models describing the dissipation of radiation entering the earth's atmosphere as sunshine or energetic electrons are also necessary to predict global warming or cooling. The revised rate coefficients have been incorporated into the Strategic High Altitude Radiance Code (SHARC) 2.0, 1991. GRA

N92-13516# Naval Postgraduate School, Monterey, CA.

THE DESIGN OF A NEW FAR ULTRAVIOLET INTERFEROMETER FOR IONOSPHERIC SPECTROSCOPY M.S. Thesis

James W. Nichols Dec. 1990 76 p

(AD-A241767) Avail: NTIS HC/MF A05 CSCL 04/1

A new far ultraviolet interferometer for ionospheric spectroscopy was designed and tested. The design uses a concave spherical grating in an off-plane Rowland circle configuration. Wave fronts are split into zero and negative first order diffractions, reflected by plane mirrors and recombined by the spherical grating to produce interference fringes. Use of a single concave grating reduces the total number of reflections to three for each path. The off-plane configuration was required to obtain equal path lengths. The ruling density was selected to eliminate other diffracted orders. The design was tested by: (1) verifying the feasibility of recombining a divided wave front using two similar flat transmission gratings; and (2) by using a concave grating interferometer using a helium neon laser as the source. The design produced a high quality fringe pattern suitable for spectroscopic analysis. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-13517 Columbia Univ., New York, NY.

MODELING SEA SURFACE TEMPERATURE AND LOW-LEVEL WINDS IN THE TROPICS Ph.D. Thesis

Richard Seager 1990 115 p

Avail: Univ. Microfilms Order No. DA9118641

Some steps towards development of a coupled, reduced physics, model of the tropical atmosphere and ocean climatology are presented. The work divides into three parts--a model of the tropical Pacific sea surface temperature (SST) climatology, a study of the interannual variability of SST using this model, and a model of the low level wind field in the tropics. The first part describes a model of the climatological SST of the tropical Pacific ocean. The upper ocean response is computed using a time dependent, linear, reduced gravity model with the addition of a constant depth frictional surface layer. The three dimensional temperature equation and a surface heat flux parameterization that requires specification of only wind speed and total cloud cover are used to evaluate the SST. The model simulates the major features of the observed SST and their seasonal evolution. We then compute the SST of the tropical Pacific for the period between January 1970 and September 1987, using observed winds as forcing. Variability with periods longer than one year, including each El Nino event in the time interval, is well represented in the model. Finally a simple model of the low level wind field in the entire tropics is presented. The dynamics are linear, steady state, contained within a single baroclinic mode and damped by Rayleigh friction. Convective heating is computed with reference to buoyancy criteria and the cloud model of Yanai et al. (1973). Radiative cooling is represented by a Newtonian cooling to an equilibrium lapse rate. Conclusions as regards the essential physics operating in the tropical atmosphere and suggestions for future work are presented.

Dissert. Abstr.

N92-13518 Nevada Univ., Reno.

AN EXPERIMENTAL STUDY OF ELECTRIC CHARGING DURING ICE GROWTH AND EVAPORATION Ph.D. Thesis

Yayi Dong 1990 141 p

Avail: Univ. Microfilms Order No. DA9119933

A laboratory study was carried out to investigate electric charge acquired during growth and evaportion of water drops, ice crystals and rime suspended in a diffusion chamber under controlled conditions. During growth from the vapor a positive charge is acquired by ice at temperatures below -4 C, which reverses in sign at higher temperatures. In contrast, water growing by condensation acquires a negative charge at +10 to -8 C. The current density is about +/- 10(exp -16) A cm(exp -2). During evaporation ice acquires a negative charge, with a current density proportional to evaporation rate reaching 5 times higher than that during growth. Removal of ions in the air removes charging current during vapor growth, but has no effect on the charging current during evaporation; this observation implies that the charge separation during vapor growth is an ion collection process, but is a different process during evaporation, which may cause loss of charge directly to the air. Secondary ice crystals are produced during soft hail evaporation; charge separation accompanies this process. The most striking phenomenon is the much higher rate of charge accumulation associated with vapor growth on a freshly rimed ice surface. The current density is 5 to 10 times higher than that on non-rimed ice and the charge sign reverses from positive to negative when temperature decreases to below about -15 C. With rimed ice maintained at an electric potential, the charge current increases rapidly with increasing potential, the sign of acquired charge on the ice particle being opposite to the sign of the applied potential. The apparent voltage difference on the rimed ice during growth from vapor varies from a few tens millivolts to about a few hundred millivolts, depending on the electric potential applied. This indicates that a charge greater than 10(exp -15) C can be transferred during ice-soft hail collision due to the volume potential difference between the soft hail and ice crystals. The charge transferred may be higher taking into account a surface potential at a freshly rimed ice surface. This is enough to give rise to charge separation rates observed in thunderstorms.

Dissert. Abstr.

N92-13519 California Univ., Davis.

OBJECTIVE CLASSIFICATION OF WIND FIELD PATTERNS IN SOUTHERN CALIFORNIA AND THE RELATIONSHIP OF THESE PATTERNS TO FIELDS OF THE EXTINCTION COEFFICIENT, PRESSURE AND SPECIFIC HUMIDITY Ph.D. Thesis

Mark Charles Green 1990 247 p

Avail: Univ. Microfilms Order No. DA9118375

A methodology was developed to objectively group days having

similar surface wind field characteristics, including similar diurnal variations. This methodology was applied using the hourly vector wind for a two year period at many locations in southern California. The criteria for similarity was based upon the hourly expansion coefficients of the first eigenvector for an empirical orthogonal function analysis of the vector wind. A form of cluster analysis was developed to form groups of days, i.e., types, having similar wind field characteristics. Hourly best fit wind fields were then generated for each type. Averaged hourly fields of the extinction coefficient, pressure, and specific humidity were computed for each type. The results showed that different types showed distinct differences between their pressure, extinction coefficient and specific humidity fields. Discussion of results focused on interaction of air between the San Joaquin Valley and Mojave Desert and the Los Angeles Basin and Mojave Desert. This specifically considered the wind, extinction coefficient and specific humidity at the pass sites separating these areas. The wind field was shown to be, in general, an ageostrophic response to the pressure field. The specific humidity showed generally close relationships to the wind and extinction coefficient fields. The moisture from the San Joaquin Valley was less diluted by drier air than the moisture from the Los Angeles Basin when reaching the Mojave Desert. This implies a more efficient exchange of air between the San Joaquin Valley and Mojave Desert than between the Los Angeles Basin and Mojave Desert. Dissert. Abstr.

N92-13520*# Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.

SOUTH PACIFIC CONVERGENCE ZONE AND GLOBAL-SCALE CIRCULATIONS Final Report, 20 Jul. 1987 - 19 Jul. 1991

Dayton G. Vincent 24 Jul. 1991 12 p

(Contract NAS8-37127)

(NASA-CR-184210; NAS 1.26:184210) Avail: NTIS HC/MF A03 CSCL 04B

The major goals of the research can be classified under three categories: (1) heat and moisture budget studies in the tropics; (2) the role of tropical forcing on subtropical wind maxima in the Southern Hemisphere; and (3) general circulation modeling of low latitude circulations. Research related to the first goal included budget estimates of precipitation, as well as a comparison to rainfall rates observed at numerous island stations. It also included a comparison between observed and satellite estimates of precipitable water. Results and methods used to achieve this goal are given. Included in the second research goal were diagnostic studies of the intraseasonal oscillation which is known to be an important component of organized tropical convection. Also, the role of extratropical forcing on subtropical wind maxima was examined through the use of Eliassen-Palm (EP) fluxes. Again, results and procedural details are discussed in section 3. To accomplish the third research goal, the GLA general circulation model (GCM) was ported to Purdue University and successfully used in a number of control and experimental runs to investigate the significance of tropical heating on subtropical and extratropical circulation features. As with the first two research goals, results and methodology are detailed. Documentation of publications, theses, conference preprint papers, and other scientific information relevant to the research results and significant accomplishments achieved under the contract are given. Finally, the conclusions of the sponsored research are given. Author

N92-13521*# Wisconsin Univ., Madison. Space Science and Engineering Center.

APPLICATION OF LIGHTNING DATA TO SATELLITE-BASED RAINFALL ESTIMATION Final Report, 1 Jan. 1989 - 31 Dec. 1991

David W. Martin, Barry B. Hinton, and Brian A. Auvine 15 Oct. 1991 37 p

(Grant NAGw-1767)

(NASA-CR-188963; NAS 1.26:188963) Avail: NTIS HC/MF A03 CSCL 04B

Information on lightning may improve rain estimates made from infrared images of a geostationary satellite. We address this proposition through a case from the Cooperative Huntsville Meteorological Experiment (COHMEX). During the afternoon and evening of 13 July 1986 waves of showers and thunderstorms developed over and near the lower Tennessee River Valley. For the shower and thunderstorm region within 200 km of the National Weather Service radar at Nashville, Tennessee, we measure cold-cloud area in a sequence of GOES infrared images covering all but the end of the shower and thunderstorm period. From observations of the NASA/Marshall direction-finding network in this small domain, we also count cloud-to-ground lightning flashes and, from scans of the Nashville radar, we calculate volume rain flux. Using a modified version of the Williams and Houze scheme, over an area within roughly 240 km of the radar (the large domain), we identify and track cold cloud systems. For these systems, over the large domain, we measure area and count flashes; over the small domain, we calculate volume rain flux. For a temperature threshold of 235K, peak cloud area over the small domain lags both peak rain flux and peak flash count by about four hours. At a threshold of 226K, the lag is about two hours. Flashes and flux are matched in phase. Over the large domain, nine storm systems occur. These range in size from 300 to 60,000 km(exp 2); in lifetime, from about 2 1/2 h to 6 h or more. Storm system area lags volume rain flux and flash count; nevertheless, it is linked with these variables. In essential respects the associations were the same when clouds were defined by a threshold of 226K. Tentatively, we conclude that flash counts complement infrared images in providing significant additional information on rain flux. Author

N92-13522*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AERODYNAMIC DESIGN OF GAS AND AEROSOL SAMPLERS FOR AIRCRAFT

Paul T. Soderman, Nathan L. Hazen, and William H. Brune (Pennsylvania State Univ., University Park.) Sep. 1991 15 p

(NASA-TM-103854; A-91110; NAS 1.15:103854) Avail: NTIS HC/MF A03 CSCL 04B

The aerodynamic design of airborne probes for the capture of air and aerosols is discussed. Emphasis is placed on the key parameters that affect proper sampling, such as inlet-lip design, internal duct components for low pressure drop, and exhaust geometry. Inlet designs that avoid sonic flow conditions on the lip and flow separation in the duct are shown. Cross-stream velocities of aerosols are expressed in terms of droplet density and diameter. Flow curvature, which can cause aerosols to cross streamlines and impact on probe walls, can be minimized by means of a proper inlet shape and proper probe orientation, and by avoiding bends upstream of the test section. A NASA panel code called PMARC was used successfully to compute streamlines around aircraft and probes, as well as to compute to local velocity and pressure distributions in inlets. A NACA 1-series inlet with modified lip radius was used for the airborne capture of stratospheric chlorine monoxide at high altitude and high flight speed. The device has a two-stage inlet that decelerates the inflow with little disturbance to the flow through the test section. Diffuser design, exhaust hood design, valve loss, and corner vane geometry are discussed. Author

N92-13523*# University of South Florida, Tampa. Dept. of Physics.

COMPARISON OF 2 MICRON Ho AND 10 MICRON CO2 LIDAR FOR ATMOSPHERIC BACKSCATTER AND DOPPLER WINDSHEAR DETECTION Progress Report, Mar. 1990 - Oct. 1991

Dennis Killinger 22 Nov. 1991 48 p

(Grant NAG1-1104)

(NASA-CR-189471; NAS 1.26:189471) Avail: NTIS HC/MF A03 CSCL 04B

The development of eye-safe, solid-state Lidar systems is discussed, with an emphasis on Coherent Doppler Lidar for Atmospheric Wind Measurements. The following subject areas are covered: tunable Ho DIAL (Differential Absorption Lidar)/lidar atmospheric measurements; atmospheric turbulence measure-

ments and detector arrays; diurnal measurements of C(sub n)(sup 2) for KSC lidar measurements; and development of single-frequency Ho laser/lidar. Author

N92-13524# Coleman Research Corp., Huntsville, AL.
EXPENDABLE AIR VEHICLES. HIGH ALTITUDE BALLOON TECHNOLOGY, PHASE 1 Final Report, 31 Jan. 1990 - 2 Aug. 1991
2 Aug. 1991 365 p
(Contract DAAH01-90-C-0234)
(AD-A240827; CHR/91-2750) Avail: NTIS HC/MF A16 CSCL 04/2

The development of a digital computer simulation for high altitude, scientific balloon drift pattern prediction is described. Provision is made for the use of either wind forecast data or a worldwide, empirical atmospheric data base. The program operates on a Macintosh computer and produces on-screen drift patterns which may be imported into commercially available graphics programs for annotation and/or printing. The report includes a listing of the FORTRAN source code for the program. The Defense Advanced Research Projects Agency (DARPA) is interested in exploiting high-altitude, expendable balloon borne communication and surveillance capabilities for military applications. Balloons offer several unique capabilities when high altitude balloon technologies are integrated with payloads employing the power efficient, light weight electronic technologies available today. The first technical objective to be met was the development of a suitable atmosphere model for use within the Balloon Drift Pattern Simulation (BDPS). Since BDPS was intended to be used as a deployment tool, the atmosphere model was of critical importance because the wind would have the most significant impact on balloon motion. GRA

N92-13525# Massachusetts Univ., Amherst.
MEASUREMENTS OF OCEAN SURFACE WIND SPEED WITH THE SPECIAL SENSOR MICROWAVE/IMAGER (SSM/I) Final Report, Apr. 1990 - Jul. 1991
M. A. Goodberlet and C. T. Swift 26 Jun. 1991 37 p
(Contract F19628-90-K-0034)
(AD-A241318; PL-TR-91-2179) Avail: NTIS HC/MF A03 CSCL 04/2

An improved algorithm which can be used to estimate ocean surface wind speed from radiometric data collected by the Defense Meteorological Space Program's (DMSP) Special Sensor Microwave/Imager (SSM/I) is proposed. As compared to the previous DMSP wind speed algorithm, retrievals of the improved algorithm are unbiased under a wider range of weather conditions. The improved algorithm also calculates accuracy flags which indicate the specific accuracy of each wind speed retrieval. A retrieval accuracy of better than 2 m/s for over 85 percent of the global wind speed measurements can be expected. GRA

N92-13526# Naval Postgraduate School, Monterey, CA.
EVALUATION OF THE SSM/I RAIN ANALYSES FOR SELECTIVE STORMS IN THE ERICA PROJECT M.S. Thesis
Edmund F. Cataldo, III Sep. 1990 94 p
(AD-A241321) Avail: NTIS HC/MF A05 CSCL 09/2

Evaluation of the Special Sensor Microwave/Imager (SSM/I) Hughes Aircraft Company (HAC) precipitation algorithm is presented. SSM/I rain rate data from five passes during ERICA (Experiment of Rapidly Intensifying Cyclones over the Atlantic) intensive observing periods (IOP) 2 and 3 were compared to all available ship observations, dropwinsonde soundings and coastal radar. Four different techniques were applied to the seven SSM/I channels to analyze rain rate. They are: SSM/I HAC algorithm, the Tb(19H) GHz channel with a threshold of 160 K, the Tb(37H) GHz channel with a threshold of 190 K, and the Tb(37V-37H) image with a threshold of less than a 30 K difference. For the two IOP 2 passes the Spencer et al (1989) Polarized Correction Temperature (PCT) algorithm using the two 85 GHz channels were also studied. There is considerable uncertainty in the interpretation of the SSM/I HAC rain rate algorithm. Specifically, large areas of out-of-limit values are present in the vicinity of mid-latitude winter cyclones. Study of the SSM/I HAC rain rate has indicated the out-of-limit areas occur when the rain flag is triggered, but the calculated rain rate from the HAC algorithm is less than zero. From this study it is obvious that the four channel SSM/I HAC regression algorithm, in its current form, can not satisfactorily analyze the precipitation. Further study is needed to determine if a regression equation can be used to estimate precipitation areas, particularly those with light precipitation. Treating the out-of-limits values as light precipitation would dramatically improve the quality of the SSM/I HAC analysis. GRA

N92-13527# Naval Postgraduate School, Monterey, CA.
THE PATH PREDICTION OF CYCLONES WITH KALMAN FILTERS M.S. Thesis
Dogan Taskin Sep. 1990 81 p
(AD-A241376) Avail: NTIS HC/MF A05 CSCL 04/2

The Kalman filter is used to provide estimates of the position and velocity of a storm based upon observation of the storm's longitude and latitude. Nonstationary noise is shown to degrade the performance of the filter and cause tracking divergence. Time varying values for the noise covariance matricies R and Q, and the addition of an external forcing function to the filter, effectively compensated for this tracking error. Results for the simulations show significant performance advantages of using an external forcing function in the system. GRA

N92-13528# Phillips Lab., Hanscom AFB, MA.
NOWCASTING CLOUD AND PRECIPITATION FIELDS USING THE REMOTE ATMOSPHERIC PROCESSING AND INFORMATION DISPLAY (RAPID) SYSTEM
Frank H. Ruggiero and Kenneth F. Heideman 8 Oct. 1991 9 p
(AF Proj. 6670)
(AD-A241662; PL-TR-91-2240) Avail: NTIS HC/MF A02 CSCL 22/2

The Remote Atmospheric Processing and Information Display (RAPID) System has been developed at the Geophysics Directorate of Phillips Laboratory to provide an environment for the creation and testing of image processing techniques of remotely sensed data. The first objective of RAPID was to provide nowcasts of cloud and precipitation fields. This is done for cloud fields by tracking and extrapolating contours of infrared bright temperatures from a geostationary satellite. Precipitation fields are forecast by tracking and extrapolating radar reflectivity contours. Currently, there are three techniques in RAPID to extrapolate the future position and shape of contours. The three techniques are the Whole Contour, Segmentation, and Statistical Extrapolation methods. The are all similar in that the contours are represented mathematically, the mathematical features are extrapolated out in time, and forecasted features are used to construct the forecast contour. Tests of the three techniques were conducted using data from the GOES satellite (IR) and the Phillips Laboratory's 10-cm Doppler weather radar. The initial results indicate that, for both satellite and radar data, all three methods do show skill with respect to persistence and produce forecasts that are comparable to each other. GRA

N92-13529# Air Force Geophysics Lab., Hanscom AFB, MA.
REFINEMENT AND TESTING OF THE MOIST CONVECTION PARAMETERIZATION IN THE GL GLOBAL SPECTRAL MODEL Interim Report, 6 Jun. 1986 - 31 Mar. 1990
Donald C. Norquist and Chien-Hsiung Yang 22 Oct. 1990 135 p
(AD-A241684; GL-TR-90-0285; ERP-1067) Avail: NTIS HC/MF A07 CSCL 04/2

An evaluation of the original version of the advanced physics moist convection parameterization revealed excessive heating and precipitation being produced by the scheme within the global spectral model. This report describes a series of corrections and modifications made to the parameterization software to improve its performance. Forecast experiments were conducted to determine the effectiveness of each modification. Turning off the entrainment formulation, using a newly developed scheme for computing the lifting condensation level and moist adiabat, employing a center-difference scheme for computing moisture

convergence, and allowing evaporation of falling precipitation in the cloudy portion of the grid box yielded the most realistic convective heating and precipitation. This version of the convective scheme was used in a series of 10-day global spectral model forecasts. Global and zonal average distributions of precipitation agreed well with climatological estimates for the same months. Although the modified version of the scheme resulted in substantially reduced convective precipitation, it still produced more than was observed in areas of high climatological rainfall. In the tropics, the modified convective scheme produces too much precipitation in areas characterized by heavy precipitation, and not enough precipitation in the more arid regions. In the extratropics, wintertime convection downstream from continents (typically involved in cyclogenesis) was simulated by th GRA

N92-13530# Naval Postgraduate School, Monterey, CA.
MESOSCALE SURFACE ANALYSES OF THE ERICA IOP-2 CYCLONE M.S. Thesis
Craig D. Lilly Dec. 1990 77 p
(AD-A241817) Avail: NTIS HC/MF A05 CSCL 04/2

The mesoscale structure of an explosively deepening open-ocean cyclone, the Intensive Observation Period (IOP) 2 of the Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA) which occurred 13-14 December 1988, was studied. Aircraft, buoy, and ship observations were plotted in 3 h blocks, and detailed hand-analyses of surface pressure and temperature, as well as frontal and cyclone structure, were prepared. The analyses were then converted to a 20 km grid using a Cressman analysis scheme, and the gridded fields passed to a Brown-Liu planetary boundary layer (PBL) model to calculate surface latent and sensible heat fluxes. The results of the mesoscale surface analysis showed that the regions east and northeast of the low featured cooler thermal advection than expected for a typical maritime cyclone and a low-level easterly flow that had a 5-10 C thermal nonequilibrium between the sea surface and the overlying air. This caused substantial positive heat fluxes east of the low throughout the 12 h prior to and during rapid deepening. This pattern of surface interaction is substantially different from other cyclones and suggests that surface processes contributed significantly to the cyclogenesis. GRA

N92-13531# International Centre for Theoretical Physics, Trieste (Italy).
SUN-CONTROLLED SPATIAL AND TIME-DEPENDENT CYCLES IN THE CLIMATIC/WEATHER SYSTEM
E. C. Njau Nov. 1990 15 p
(DE91-635151; IC-90/394) Avail: NTIS HC/MF A03

We show, on the basis of meteorological records, that certain spatial and time-dependent cycles exist in the earth-atmosphere system (EAS). These cycles seem to be associated with sunspot cycles and hence have been referred to in the text as data-derived solar cycles. Our analysis establishes three important characteristics of the data-derived solar cycles (DSC's). Firstly the crests and troughs of these data-derived solar cycles are mostly latitudinally aligned and have (zonal) spatial wavelengths greater than about 7 degrees of longitude. Secondly the DSC's have periods mostly lying between 6 years and 12 years. In certain stations, some DSC's coincide quite well with corresponding sunspot cycles. Thirdly the crests and troughs of the DSC's drift eastwards at speeds exceeding about 1.5 longitude degrees per year. Furthermore, these DSC's display peak-to-peak amplitudes of about 2 C along East Africa. On the basis of earlier work and bearing in mind the considerable temperature-dependence of the stratospheric ozone layer, we predict existence of latitudinally aligned enhancement and depletion structures (corresponding to the DSC's) in the stratospheric ozone layer within cloudless midnight-to-predawn sectors. DOE

N92-13532# International Centre for Theoretical Physics, Trieste (Italy).
PREDICTION OF METEOROLOGICAL PARAMETERS-3: RAINFALL AND DROUGHTS
E. C. Njau Nov. 1990 26 p
(DE91-635152; IC-90/395) Avail: NTIS HC/MF A03

We describe two new methods by which rainfall and hence meteorological droughts at any location on the earth may be predicted. The first method is based upon well supported observations that rainfall distribution at a given location during any local sunspot-related temperature/heat cycle is approximately similar to the distribution during another cycle associated with approximately similar sunspot cycle provided that the two temperature/heat cycles involved are immediately preceded by approximately similar sunspot cycles. The second method is based upon the fact that rainfall belts or patterns seem to be closely related to certain spatial and time-dependent temperature/heat patterns in the earth-atmosphere system. Reasonable predictions of these temperature/heat patterns may be made, and hence the associated rainfall patterns or belts may correspondingly be predicted. Specific examples are given to illustrate the two prediction methods. DOE

N92-13533# International Centre for Theoretical Physics, Trieste (Italy).
THEORY OF QUASI-BIENNIAL AND SOME OTHER OSCILLATIONS IN METEOROLOGICAL PARAMETERS
E. C. Njau Nov. 1990 15 p
(DE91-635153; IC-90/397) Avail: NTIS HC/MF A03

We show that quasi-biennial and several other oscillations in meteorological parameters are caused by foldover distortions in the physical processes represented by the formulations contained in our recent theory. The periods of all these oscillations extend from about 50 days up to over 200,000 years. Additional oscillations within and outside this periodicity range are correspondingly generated primarily as a result of non-linearities in the earth-atmosphere system. Our analysis agrees quite well with past observations as well as results of analyses on climatic records from different locations on the earth and can, therefore, be useful in attempts to make climatic predictions as briefly indicated in the text. DOE

N92-13922 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Environmental Research Dept.
SIMPLE DETERMINATION OF THE ATMOSPHERIC STABILITY CLASS FOR APPLICATION IN DISPERSION MODELLING, USING WIND FLUCTUATIONS
J. J. Erbrink *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 391-399 (For primary document see N92-13917 04-99)
Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-13534# Joint Oceanographic Inst., Inc., Washington, DC.
GLOBEC WORKSHOP ON BIOTECHNOLOGY APPLICATIONS TO FIELD STUDIES OF ZOOPLANKTON
Feb. 1991 33 p Workshop held in Miami, FL, 14-16 Nov. 1990 (Rept-3) Avail: NTIS HC/MF A03

Discussions held by various working groups at the Global Ocean Ecosystems Dynamics (GLOBEC) workshop held in Halifax, Nova Scotia in June, 1990 are summarized. Topics discussed include biochemical and molecular methods for measuring physiological rates and conditions in marine organisms; zooplankton genetics; feeding rates and dietary components of marine organisms; and sample collection of marine plankton. Author

N92-13535# Rhode Island Univ., Narragansett. Graduate School of Oceanography.
THE SYNOP EXPERIMENT: THERMOCLINE DEPTH MAPS FOR THE INLET ARRAY, OCTOBER 1987 TO AUGUST 1990 Summary Report
Karen L. Tracey and D. R. Watts Aug. 1991 142 p
(Contracts N00014-87-K-0235; N00014-90-J-1568; N00014-90-J-1548; NSF OCE-87-17144)
(AD-A240860; GSO-TR-91-6) Avail: NTIS HC/MF A07 CSCL 08/3

Between October 1987 and August 1990, two arrays of inverted echo sounders were deployed in the Gulf Stream northeast of Cape Hatteras as part of the SYNoptic Ocean Prediction Experiment. The Inlet Array consisted of 9 inverted echo sounders (IES). Centered at 74 W, the Inlet Array was designed to measure key parameters that describe the Gulf Stream path variability near Cape Hatteras. The large Central Array of 24 IESs was centered on the current near 68 W, about 400 km downstream of the Inlet Array. Spanning nearly 300 km in both the cross-stream and downstream directions, the Central Array was designed to monitor the thermocline structure of the Gulf Stream in the region of large meanders and frequent ring interactions. Using objective analysis, we have mapped the Gulf Stream thermal field measured by the IESs in the Inlet Array. In this report, the objective analysis technique is described and the mapping parameters are documented. Daily maps of the thermocline depth field are presented for the period 14 October 1987 through 31 August 1990. GRA

N92-13536# Massachusetts Inst. of Tech., Cambridge.
GLOBAL ISOTOPIC SIGNATURES OF OCEANIC ISLAND BASALTS M.S. Thesis
Lynn A. Oschmann Aug. 1991 272 p
(AD-A240862) Avail: NTIS HC/MF A12 CSCL 08/3

Sr, Nd and Pb isotopic analyses of 477 samples representing 30 islands or island groups, 3 seamounts or seamount chains, 2 oceanic ridges and 1 oceanic plateau (for a total of 36 geographic features) are compiled to form a comprehensive oceanic island basalt (OIB) data set. These samples are supplemented by 90 selected mid ocean ridge basalt (MORB) samples to give adequate representation to MORB as an oceanic basalt end-member. This comprehensive data set is used to infer information about the Earth's mantle. Principal component analysis of the OIB+MORB data set shows that the first three principal components account for 97.5 percent of the variance of the data. Thus, only four mantle end-member components (EMI, EMII, HIMU and DMM0 are required to completely encompass the range of known isotopic values. Each sample is expressed in terms of percentages of the four mantle components, assuming linear mixing. A continuous layer model is applied to the mantle component percentage data to solve for the spherical harmonic coefficients using approximation methods. Only the degrees 0-5 coefficients can be solved for since there are only 36 features. GRA

N92-13537# Naval Postgraduate School, Monterey, CA.
OCEANIC MIXED LAYER ENTRAINMENT ZONE DYNAMICS M.S. Thesis
Robert L. Beard Sep. 1990 57 p
(AD-A240896) Avail: NTIS HC/MF A04 CSCL 08/3

The Naval Postgraduate School mixed layer model is augmented to include an entrainment zone with finite thickness. The role of entrainment shear production of turbulent kinetic energy is investigated by comparing model results that include the new entrainment zone with observations at Ocean Weather Station Papa in the North Pacific and with model predictions that do not include the new entrainment zone feature. Although it is not yet clear that annual-period model forecasts are improved significantly, it is shown that the entrainment zone processes play a significant role in vertical fluxes and in the turbulent kinetic energy budget of the upper ocean under warming conditions. Furthermore, it is found that the improved entrainment zone more accurately reproduces the temperature gradients of transient thermoclines observed at OWS Papa. GRA

N92-13538# Army Cold Regions Research and Engineering Lab., Hanover, NH.
EVALUATION OF A PORTABLE ELECTROMAGNETIC INDUCTION INSTRUMENT FOR MEASURING SEA ICE THICKNESS
Austin Kovacs and Rexford M. Morey Jun. 1991 24 p
(AD-A240974; CRREL-91-12) Avail: NTIS HC/MF A03 CSCL 08/12

Field trials using a man-portable Geonics, Ltd., EM31 electromagnetic induction sounding instrument, with a plug-in data processing module, for the remote measurement of sea ice thickness, are discussed. The processing module was made by Flow Research Inc., to directly measure sea ice thickness and show the result in a numerical display. The EM31-processing module system was capable of estimating ice thickness within 10 percent of the true value for ice from about 0.7 to 3.5 m thick, the oldest undeformed ice in the study area. However, since seawater under the Arctic pack ice has a relatively uniform conductivity (2.5 plus or minus 0.05 S/m), a simplified method, which can be used for estimating sea ice thickness using an EM31 instrument, is discussed. It uses only the EM31's conductivity measurement, is easy to put into use and does not rely on theoretically derived look-up tables or phasor diagrams, which may not be accurate for the conditions of the area. GRA

N92-13539# Naval Postgraduate School, Monterey, CA.
AN ANALYSIS OF AN EDDY-RESOLVING GLOBAL OCEAN MODEL IN THE TROPICAL INDIAN OCEAN M.S. Thesis
Erik C. Long Sep. 1990 156 p
(AD-A241009; NPS68-90-008) Avail: NTIS HC/MF A08 CSCL 08/3

This paper examines the Semtner/Chervin global ocean model in the tropical Indian Ocean. The primitive equation, eddy-resolving model covers a domain from 75 S to 65 N at a horizontal resolution of 1/2 deg, with 20 vertical levels. In a new phase of an ongoing simulation, the wind stress has been changed from annual mean wind forcing to seasonal forcing, using the Hellerman/Rosenstein (1983) wind stress. The model is shown to reproduce the seasonal features of the Indian Ocean circulation. The model simulates the seasonally-reversing Somali Current, and includes seasonal undercurrents and a two-gyre system during the southwest monsoon. Westward flow occurs beneath the Southwest Monsoon Current during June and July. The major equatorial currents of the two monsoon regimes are well-represented, including semiannual Wyrtki jets and the Equatorial Undercurrent. Seasonal features of the marginally-resolved Leeuwin Current are present in the model. Monthly mass transports have been calculated for the major equatorial currents, as well as the Pacific-Indonesian throughflow, and are consistent with observations. The structure of deep equatorial jets in the model is highly baroclinic; an upward tilt in the jets from west to east accounts for simultaneous westward and upward phase propagation of the zonal velocity. The Haney (1971) method of prescribing surface heat flux is analyzed by comparing the model surface heat flux and monthly temperature fields with existing climatologies. The model is shown to exhibit an inherent interannual variability, despite the interannual invariance of the wind stress. The small amount of interannual variability is superimposed on a strong seasonal cycle. Near-surface currents in the model are in good agreement with existing studies of drifting surface bouys. GRA

N92-13540# Naval Postgraduate School, Monterey, CA.
SEASONAL VARIABILITY OF THE GEOSTROPHIC VELOCITY AND WATER MASS STRUCTURE OFF POINT SUR, CALIFORNIA M.S. Thesis
Timothy D. Tisch Sep. 1990 163 p
(AD-A241374) Avail: NTIS HC/MF A08 CSCL 08/3

The Point Sur Transect was established in 1987 by the Department of Oceanography at the Naval Postgraduate to further the present understanding of long term variability of current and temperature in eastern boundary regions. Seven of these cruises were selected for seasonal comparisons of alongshore geostrophic velocities and water mass characteristics. Geostrophic velocities

were referenced to the 1000 decibar surface based on available PEGASUS observations. Anomalies of spiciness calculated as deviations from an average offshore T-S profile have been used to identify the location and spatial extent of the eastern Pacific water masses. The California Undercurrent (positive spiciness anomaly) was a prominent feature in 6 of the 7 sections analyzed, and was very weak during a period of uncommonly strong equatorward wind stress. The position of the core varied from 12 to 42 km from shore while its strength varied from 10 to 35 cm s, with the maximum flow occurring in winter. The vertical extent of the Undercurrent core covered a region of the continental slope from 70 to 460 m throughout these seven cruises. The nature of the alongshore geostrophic velocities and the location and spatial extent of the undercurrent appear strongly related to specific wind events, both local and remote. Remote wind forcing from the south was believed to cause anomalous, strong poleward flow throughout the entire water column during a period of local equatorward wind stress, while an intrusion of warm, salty water was believed to cause a deep penetration of the California Current in winter. GRA

N92-13541# Naval Postgraduate School, Monterey, CA.
SPATIAL AND TEMPORAL VARIABILITY OF CROSS-BASIN ACOUSTIC RAY PATHS M.S. Thesis
Coenraad M. Ort Dec. 1990 90 p
(AD-A241544) Avail: NTIS HC/MF A05 CSCL 08/1

It was suggested by Munk and Forbes (1989) that climate induced changes in ocean temperature may be monitored by measurements of cross-basin acoustic travel time variability. The feasibility of such a monitoring system depends on the spatial and temporal variability of the cross-basin acoustic paths in the presence of ocean variability of many different scales. For this thesis, the variations in arrival position, azimuthal arrival angle, ray trajectory, and the corresponding changes in travel times along the three-dimensional multipaths due to meso- and gyre scale ocean temperature fluctuations were analyzed. Emphasis was placed on the acoustic paths from Heard Island in the Indian Ocean, the proposed location for the sound source, to the west coast of the United States. An optimal receiver site location was found to exist in the vicinity of Monterey Bay, California. The possibility of a proposed listening site location near Coos Bay, Oregon, was also examined. However, the ray paths to Coos Bay interact with the bottom frequently, thus rendering them less reliable. All the ray traces for this study were carried out using the recently upgraded Hamiltonian raytracing code HARPO, interfaced with output form the Semtner-Chervin eddy resolving global ocean general circulation model. This interface allows for a realistic simulation of the effects of meso- and gyre scale processes on the variability of the various cross-basin paths. GRA

N92-13542# Coastal Engineering Research Center, Vicksburg, MS.
PARAMETRIC DESCRIPTION FOR A WAVE ENERGY SPECTRUM IN THE SURF ZONE Final Report
Jack E. Davis, Jane M. Smith, and C. L. Vincent Sep. 1991 45 p
(AD-A241603; CERC-MP-91-11) Avail: NTIS HC/MF A03 CSCL 08/3

The work described in this report characterizes the shoaling and breaking processes of wave-energy spectra by describing their limiting form in the surf zone. The Field Research Facility spectral description was fit to laboratory spectra, and linear regressions were performed to determine functional relationships between the spectral parameters and environment variables such as peak spectral period (wavelength), total spectral energy, and water depth. The spectral representation for shoaling and breaking spectra was coded in a numerical spectral wave model that was used to simulate the laboratory data. The model and laboratory results were compared. While the simulation did not verify the spectral representation, it did indicate the feasibility of the approach. GRA

N92-13543# Coastal Engineering Research Center, Vicksburg, MS.
ANNOTATED BIBLIOGRAPHY OF RELATIVE SEA LEVEL CHANGE Final Report
Laurel T. Gorman Sep. 1991 197 p
(AD-A241604; CERC-TR-91-16) Avail: NTIS HC/MF A09 CSCL 08/5

This report summarizes 377 abstracts on the relative change of sea level that have been published through 1989. Articles cited in this bibliography include references to global, regional, and local sea level changes with emphasis on quantitative data analysis. Coastal and geological processes that affect sea level change are discussed in the background section. A cross-referenced keyword index and a subject index are included. GRA

N92-13544# Naval Postgraduate School, Monterey, CA.
MIXED LAYER DYNAMICS IN THE ONSET OF FREEZING M.S. Thesis
Dennis C. Claes Dec. 1990 110 p
(AD-A241787) Avail: NTIS HC/MF A06 CSCL 08/3

A two layer ocean mixed layer model is used to study the relationship between onset of freezing and mixed layer depth, wind forcing, surface buoyancy flux, and temperature and salinity changes between the two layers. Universal nondimensional parameters for stability and surface forcing are derived and related to the maximum freezing rate. Analytic solutions to the model are found in terms of the universal parameters and the model turbulent mixing tuning constants. Sensitivity studies show the dependence of the freezing rate on the stability as defined by the salinity and temperature jumps, the forcing by wind stress and surface heat flux, and the mixed layer depth. Results show that an increase in heat flux produces a nearly linear increase in the freezing rate. Mixing energy from the wind, proportional to the wind speed cubed, results in a nearly linear decrease in freezing rate. There is a nonlinear relationship between the temperature jump between layers and the freezing rate. Warming of the deeper layer decreases the freezing rate and ultimately prevents freezing. A nonlinear relation was also found between the salinity jump and freezing rate. Increase in the deeper layer salinity causes an increase in the freezing rate and leads to the maximum expected freezing rate. A nearly hyperbolic relationship between the mixed layer depth and freezing rate was found. GRA

N92-13545# Naval Postgraduate School, Monterey, CA.
A NUMERICAL STUDY OF EDDY STEERING BY BACKGROUND FLOWS M.S. Thesis
Ray T. Huddleston, Jr. Dec. 1990 63 p
(AD-A241828) Avail: NTIS HC/MF A04 CSCL 08/3

Gulf Stream warm core rings are intense, isolated eddies which form to the north of the Gulf Stream from cutoff meanders which detach from the Stream. After their formation they are embedded in the cooler slope water which flows generally westward, impinging on the continental slope near 70 W. Observations indicate that the slope water flows westward at approximately 5 cm/s. In this study, the effect of background shear flows on anticyclonic eddy motion is examined using a two layer primitive equation model. The effect of various lateral shear profiles is considered for barotropic and equivalent barotropic eddies. Results indicate that eddy zonal propagation is dependent on the eddy initial vertical profile and form of the background shear lateral profile. Eddy meridional speeds are found to be insensitive to background shear profile or strength. GRA

51 LIFE SCIENCES (GENERAL)

N92-13546# Oak Ridge National Lab., TN.
LUMINESCENCE AND RAMAN SPECTROSCOPY FOR BIOLOGICAL ANALYSIS
Vo-Dinn Tuan 14 Jun. 1990 5 p

(Contract DE-AC05-84OR-21400)
(DE90-013225; ORNL/FTR-3646) Avail: NTIS HC/MF A01

The traveler was invited to present a seminar on Immunofluorescence and Raman Fiberoptic Chemical Sensors, at the Laboratory FOCAL of CEN-FAR, France. The traveler visited the CEN-FAR laboratories involved in laser-based spectroscopy and remote monitors and conducted scientific discussions with research staff at CEN-FAR. The traveler was also invited to present an invited lecture on Advances in Luminescence and Raman Spectroscopy for Chemical and Biological Analysis, at the Laboratory of Molecular Photophysics and Photochemistry, University of Bordeaux, Talence, France. The traveler visited the laboratories involved in the development of luminescence techniques for the analysis of polyaromatic pollutants and related biomarkers. The traveler conducted discussions on potential research collaboration with scientists at the University of Bordeaux. The traveler was awarded a North atlantic Treaty Organization (NATO) Collaborative Grant to conduct joint research with Professor P. Viallet, head of the Laboratory of Quantitative Microfluorimetry, University of Perpignan. The traveler was involved in experimental luminescence studies of bioindicators of polyaromatic pollutants (DNA adducts, metabolites). DOE

N92-13547# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
NEUROLOGICAL, PSYCHIATRIC AND PSYCHOLOGICAL ASPECTS OF AEROSPACE MEDICINE
Sep. 1991 80 p Course held in Pensacola, FL, 18-20 Oct. 1989, in Brussels, Belgium, 25-27 Oct. 1989, and in Ankara, Turkey, 30 Oct. - 1 Nov. 1989
(AGARD-AG-324; ISBN-92-835-0631-6) Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

An overview of the neurological, psychiatric, and psychological aspects of aerospace medicine is presented. The purpose is to further the knowledge of the flight surgeon and aeromedical examiner in the issues of neuropsychiatry. Aeromedical information is provided for the neuropsychiatric specialist. The unique application of psychiatry, psychology, and neurology to the aviation environment is described. Topics such as motivation to fly, human performance, stress in aviation, and the failing aviator are discussed. Further psychiatric and neurologic disorders found among aviators are presented. The unique aspects of assessment and decision making about flying status among neuropsychiatric cases are presented. The concepts and information currently available in aeromedical neuropsychiatry are summarized. For individual titles, see N92-13548 through N92-13566.

N92-13548# Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).
THE PILOT FLIGHT SURGEON BOND **c53**
J. R. Galle-Tessonneau *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 5 p (For primary document see N92-13547 04-51)
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To become a physician it is necessary to learn medicine and to know diseases, but it is also necessary to have some notions about medicine psychology. To become a flight surgeon, it is necessary to know medicine and aeronautic medicine, but it is also necessary to have some notions about pilot psychology and pilot-flight surgeon relationships. Pilots are not ordinary patients; pilots present some particularities about health, diseases, medicine, and physicians. In the psychological cause, an initiation in theoretical notions and practical attitudes likely to clarify and make understandable phenomena which would otherwise risk appearing unintelligible is presented for the benefit of flight surgeons. As an introduction, three specific and important aspects in the psychology of a pilot are presented: his body, his motivation, and his environment. Author

N92-13549# School of Aerospace Medicine, Brooks AFB, TX.
INTRODUCTION TO AEROSPACE NEUROLOGY **c52**
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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The bottom line in aerospace neurology is the evaluation for the: (1) potential of sudden incapacitation, e.g., post traumatic seizures; (2) possibility of a sudden neurological deficit which would prevent the aircrew member from performing their job and thereby affect mission completion, flight or personal safety, e.g., neurologic deficits with headaches; and (3) risk of any neurologic or neuropsychologic deficit which would persist after the initial injury, e.g., post traumatic syndrome. Reasonable criteria for making an aeromedical decision in specific neurological syndromes are presented, and some work up guidelines are established. Areas of controversy are identified, and the aeromedical issues involved are raised. Author

N92-13550# Institute of Aviation Medicine, Oslo (Norway).
AVIATION PSYCHOLOGY IN THE OPERATIONAL SETTING **c53**
Grete Myhre *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 4 p (For primary document see N92-13547 04-51)
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Being an aviation psychologist in a small airforce has its advantages, since one has to cover a wide spectrum of tasks, compared to the aviation psychologist in a large airforce who has to specialize in one or two fields. The main tasks of an aviation psychologist are discussed and include the following: (1) teaching flying personnel aviation psychology; (2) acting as a consultant to the aviators on personal matters; (3) performing surveys on the flying personnel's social and working conditions; (4) assisting the flight surgeons on medical boards; (5) acting as a member on aviation accident boards where human factors are involved; and (6) acting as a consultant in an operational setting. Two case histories are discussed that involve fighter pilots who ejected from their aircraft. Author

N92-13551# Jones (David R.), San Antonio, TX.
PSYCHIATRIC DISORDERS IN AEROSPACE MEDICINE: SIGNS, SYMPTOMS, AND DISPOSITION **c53**
David R. Jones *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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The major categories of psychiatric diagnosis and how a few that are more commonly seen in aviators may affect flying duties are considered. Major psychotic disorders are always disqualifying, as are affective disorders, manic or depressive. Lesser depressive disorders may not be so, depending on the depth of symptoms, the reaction of the flyer, and his/her insight into the condition. Neurotic disorders may or may not require grounding, again depending on the degree of symptoms. Organic mental disorders are generally cause for permanent grounding, unless the cause is reversible and not likely to occur again (e.g., acute toxic reactions). Personality disorders are always troublesome, and are likely to be handled through administrative rather than medical channels. The general symptoms involved in these disorders are discussed in a later presentation. Psychiatric disorders are frequently underdiagnosed, both because operational personnel may not recognize these ailments for what they are and because of the tendency of some non-flying psychiatrists and psychologists to shield the flier from grounding by not accurately diagnosing what they see; by avoiding its proper name. This dangerous practice may allow possible dysfunctional fliers to fly, and deny them adequate treatment, specifically, medications. Author

N92-13552# Letterman Army Inst. of Research, San Francisco, CA.
PSYCHOLOGICAL FACTORS INFLUENCING PERFORMANCE AND AVIATION SAFETY, 1 **c53**
James J. Picano *In* AGARD, Neurological, Psychiatirc and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Two major psychological factors which can adversely affect health, flight performance, and decision making in aviation personal are discussed: stress and hazardous thought patterns. A model for understanding stress and appraising its effects on human performance in aviation is presented. Understanding the effects of stress on health and performance is essential to designing and implementing proactive preventive programs aimed at promoting and preserving the health and welfare of pilots and enhancing aviation safety. Author

N92-13553# School of Aerospace Medicine, Brooks AFB, TX.
UNEXPLAINED LOSS OF CONSCIOUSNESS **c52**
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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The unexplained loss of consciousness in aircraft crews is discussed, with emphasis on diagnosis. The several reasons for loss of consciousness are surveyed. The evaluation of unexplained loss of consciousness requires a detailed history from the subject and eye witnesses, and evaluation of vital signs and a physical and neurological examination, along with both detailed cardiovascular and neurological workups. Author

N92-13554# Letterman Army Inst. of Research, San Francisco, CA.
ASSESSING ADAPTABILITY FOR MILITARY AERONAUTICS **c53**
James J. Picano *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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It is said that the most important sources of information regarding the potential adaptability of a pilot candidate is the flight surgeon's own response and impression regarding the individual. While this is a valid and important source of information, the flight surgeon must be careful not to rely on stereotyped or idiosyncratic ideas of what constitutes adaptability. As of yet, there is no convenient or accurate way of assessing adaptability for military aeronautics either psychometrically or by life history criteria. The information presented here serves as a guideline for the aeromedical examiner. If there is any doubt about the psychological suitability of an individual for military aeronautics, a consultation with a psychiatrist or psychologist familiar with aviation is recommended. Author

N92-13555# Institute of Aviation Medicine, Oslo (Norway).
DOMESTIC PROBLEMS AND AVIATOR FAMILY SUPPORT **c53**
Grete Myhre *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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The usefulness of wives' squadron groups in helping the wives of military pilots deal with their unique family situations is discussed. General psychology in relation to crisis situations is discussed, especially dealing with the feelings of grieving, loss, and mourning following an accident. Case studies are presented. Author

N92-13556# Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).
FEAR OF FLYING **c53**
J. R. Galle-Tessonneau *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 6 p (For primary document see N92-13547 04-51)
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When a flyer talks about his apprehension about flying, it becomes a source of concern for his fellow pilots and leaders. Clinical aspects of the fear of flying are reviewed. Clinical forms with predominantly somatic expressions, forms with anxious expression, and neutoric disorders after an accident are discussed. Predisposing factors, promoting factors, triggering factors and prognosis are covered, as well as treatment. Author

N92-13557# School of Aerospace Medicine, Brooks AFB, TX. Aerospace Clinical Psychology Function.
PSYCHOMETRIC EVALUATION TECHNIQUES IN AEROSPACE MEDICINE **c53**
John C. Patterson *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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The role of psychometric evaluation techniques in aerospace medicine is discussed, with emphasis on the use of psychological evaluation in making the decision of whether a pilot should return to flying after an illness. Aspects of the clinical review and psychological testing are discussed. It is argued that psychological testing should result in relevant recommendations about flying status based on the examiner's experience and the specific evaluation of the aviator. Author

N92-13558# Letterman Army Inst. of Research, San Francisco, CA.
PSYCHOLOGICAL FACTORS INFLUENCING PERFORMANCE AND AVIATION SAFETY, 2 **c53**
James J. Picano *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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The psychological status of the pilot as it relates to performance is discussed. Two constructs related to this issue are explored: pilot judgment and hazardous thought patterns. The five basic hazardous thought patterns of anti-authority, impulsiveness, invulnerability, macho, and resignation are seen as precursors to faulty judgment. The five hazardous thought patterns represent an interesting exploration into pilot-centered processes which may mediate between an event and a pilot's decision making outcome. These constructs are in need of further validation, but education about hazardous thought patterns and the individual's appraisal of his own decision making processes could be easily incorporated into an aviator's continuing aeromedical education and training. Author

N92-13559# Jones (David R.), San Antonio, TX.
PSYCHIATRIC REACTIONS TO COMMON MEDICATIONS **c53**
David R. Jones *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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The somatic effects of most non-prescription medications that are available to pilots usually well-known to flight surgeons, but some of the effects on mental processes may not be as well understood. Some of these are reviewed. Trifluoperazine, daizepam, chlordiazepoxide, flurazepam, triazolam, and temazepam are discussed. Author

N92-13560# School of Aerospace Medicine, Brooks AFB, TX.
SEQUELAE OF HEAD INJURY **c52**

Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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Closed head injury is discussed. The Aeromedical questions, after closed head injury, can be divided into three categories: (1) the risk of permanent neurological deficit; (2) the risk of sudden incapacitation; and (3) transient neurologic and neuro-psychological deficits. Author

N92-13561# School of Aerospace Medicine, Brooks AFB, TX.
THE FAILING AVIATOR **c53**
John C. Patterson *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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The purpose is to increase the awareness and alertness in those who work with aviators about the early signs and symptoms of failure. Solutions can start by addressing the failure process early, by providing training in these areas of psychological functioning as parenting and marriage communication, by changing the selection process to include not only competitiveness and achievement, but also openness to emotional experience, and finally by improving the relationship between mental health providers, flight surgeons, and aviators. Author

N92-13562# School of Aerospace Medicine, Brooks AFB, TX.
SELECTED CONCERNS/EXCESSIVE DAYTIME SLEEPINESS **c52**
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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A retrospective study was performed involving all patients referred for the diagnosis of excessive daytime sleepiness between 1958 and 1987. A review of the literature was also performed, and the findings were compared with those reported from United States Sleep Laboratories. The evaluation of sleep disorders and the growth of sleep medicine are discussed. Author

N92-13563# School of Aerospace Medicine, Brooks AFB, TX.
MULTIPLE SCLEROSIS AND OPTIC NEURITIS **c52**
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 10 p (For primary document see N92-13547 04-51)
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The literature review of the relationship of optic neuritis (ON) in multiple sclerosis (MS) is presented. It is our goal to review the world's literature to: (1) see what subpopulation of ON was identified to be at high risk for MS; (2) present a standard for working up and diagnosing MS; and (3) suggest a policy or establish research guidelines for handling ON in the aircrew population. In addition, we reviewed the cases of ON and MS evaluated at USAFSAM over the past 15 years to look for the patterns and effects on retention and flight safety. Author

N92-13564# School of Aerospace Medicine, Brooks AFB, TX.
HEADACHE **c52**
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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Headaches of some type were reported to occur in up to 70 percent of the population of the United States at some point in their lifetime. Vascular headaches are reported in up to 20 percent of this population. Our task is to properly classify the headache, discover any triggers or unique circumstances of the headache and decide if it is aeromedically significant. Author

N92-13565# School of Aerospace Medicine, Brooks AFB, TX.
Aerospace Clinical Psychology Function.
MISHAP AFTERCARE **c52**
John C. Patterson *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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Of primary concern after a mishap are physical and somatic matters. Secondly, however, evidence is mounting that emotional and psychological adjustments to a mishap can be very important to various categories of victims who may be involved in a mishap. Relatively simple and straightforward psychological mishap aftercare principles are available and were tested in a variety of disaster scenarios. Victim identification and intervention are key concepts in mishap psychological aftercare. Author

N92-13566# Jones (David R.), San Antonio, TX.
MEDICAL OR ADMINISTRATIVE? PERSONALITY DISORDERS AND MALADAPTIVE PERSONALITY TRAITS IN AEROSPACE MEDICAL PRACTICE **c53**
David R. Jones and John C. Patterson (School of Aerospace Medicine, Brooks AFB, TX.) *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 4 p Submitted for publication (For primary document see N92-13547 04-51)
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Aeromedical/occupational decisions are hard enough to make when there is concrete evidence of disease, and they are even more difficult when the evidence consists of abstract symptoms rather than physical signs, as in the case of most psychiatric disorders. The behavior which is described concerns personality problems, which present as traits or as overt disorders. Author

N92-13567*# National Aeronautics and Space Administration, Washington, DC.
SPACE LIFE SCIENCES: PROGRAMS AND PROJECTS
Apr. 1989 20 p Original contains color illustrations
(NASA-TM-105459; NAS 1.15:105459) Avail: NTIS HC/MF A03; 18 functional color pages CSCL 06K

NASA space life science activities are outlined. Brief, general descriptions are given of research in the areas of biomedical research, space biology, closed loop life support systems, exobiology, and biospherics. Author

N92-13568# Tennessee Univ., Memphis. Dept. of Anatomy and Neurobiology.
CHANGES IN SOMATOSENSORY RESPONSIVENESS IN BEHAVING MONKEYS AND HUMAN SUB Final Technical Report, 1 Jul. 1988 - 30 Jun. 1991
Randall J. Nelson 30 Aug. 1991 24 p
(Grant AF-AFOSR-0179-88; AF Proj. 2312)
(AD-A241559) Avail: NTIS HC/MF A03 CSCL 05/8

Two sets of goals were accomplished. (1) Neurophysiological studies were conducted that indicated that sensory input to primary somatosensory (SI) cortical neurons is gated during behavior. This occurs in some regions of SI but not in others. Quantitative estimates of this gating under different behavioral circumstances are provided. Equations are described which predict the magnitude of the premovement activity during vibratory triggered trails from the vibratory responsiveness of the neurons and the amount of premovement activity exhibit in visually cued trails. (2) In psychophysical studies, reaction times (RTs) of monkeys and human subjects were determined for ballistic or targeted wrist flexion and extension movement made in response to visual and vibratory go-cues. The RT experiments indicated that humans and monkeys make ballistic movements more quickly (50-100 msec) in response to vibratory as compared to visual signals. Human subjects also make movements more quickly to a visual target if, in addition to target presentation, a vibratory cue is also given. The psychophysical studies suggest that there is a performance

benefit in using tactile in addition to visual cues to control behavior. GRA

N92-13083# Joint Publications Research Service, Arlington, VA.
RESULTS FROM PLANT GROWTH EXPERIMENTS ABOARD ORBITAL STATIONS
A. Volkov, S. Krikalev, and G. Nechitaylo *In its* JPRS Report: Science and Technology. USSR: Space 30 Jul. 1990 p 28-29 Transl. into ENGLISH from Pravda, Moscow (USSR), 22 Oct. 1989 p 3 (For primary document see N92-13081 04-12)
Avail: NTIS HC/MF A04

N92-13672*# Arizona State Univ., Tempe. Center for the Study of Early Events in Photosynthesis.
PHOTOSYNTHETIC REACTION CENTER COMPLEXES FROM HELIOBACTERIA Abstract Only
J. T. Trost, W. F. J. Vermaas, and R. E. Blankenship *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 118 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-13569# Texas Univ. Health Science Center, San Antonio.
BRAINMAP: A DATABASE OF FUNCTIONAL NEUROANATOMY DERIVED FROM HUMAN BRAIN IMAGES
26 Aug. 1991 24 p
(Contract N00014-91-J-1903)
(AD-A241263) Avail: NTIS HC/MF A03 CSCL 12/5

The goal of the BrainMap project is to promote efficient compilation, analysis, and dissemination of the rapidly growing body of information about the functional organization of the human brain which can be provided by medical imaging techniques such as PET and MRI. We have developed highly quantitative image analysis tools for PET which provide spatial localization of brain function in a standardized spatial frame (AC-PC reference frame). Database strategies have been developed to specifically address the needs of brain mapping. Most of our efforts during this quarter were devoted to the Macintosh version of BrainMap. Software development is proceeding in a timely fashion, and at present we see no major problems with completing this portion of the project on time. GRA

N92-13570# Wright State Univ., Dayton, OH.
PHYSIOLOGIC EVALUATION OF THE L1/M1 ANTI-G STRAINING MANEUVER Final Report, Sep. 1988 - Sep. 1989
Roger M. Glaser, Bertram Ezenna, and Stephen Popper Dec. 1990 15 p
(AF Proj. 7231)
(AD-A241293; AAMRL-TR-90-083) Avail: NTIS HC/MF A03 CSCL 14/2

The primary objective of this investigation was to test the use of a relatively simple (non-invasive) system to enable continuous monitoring of human muscle performance and reserve capability, as well as prediction of physical competence during repetitive execution of the L1/M1 anti-G straining maneuver (AGSM). Ten healthy volunteers tested this system while seated in a special mockup of an F-16 pilot seat. They were instructed to perform repetitive AGSM's, each at their maximal force capability. By comparing the initial force output and electromyograph magnitudes with subsequent values, an index of muscle fatigue and reserve capability can be derived. Both Fo and EMG were found able to predict physical competence for performing AGSM's. Some subjects perceived their Fo to be maintained at the original maximum voluntary contraction (MVC) level due to their maximal effort contractions. However, it was clearly seen that Fo progressively deteriorated with muscle fatigue. GRA

N92-13571# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
CIVILIAN TRAINING IN HIGH-ALTITUDE FLIGHT PHYSIOLOGY Final Report, 1 Jan. - 31 Mar. 1991
John W. Turner and Stephen Huntley, Jr. Aug. 1991 50 p
(AD-A241296; DTS-45) Avail: NTIS HC/MF A03 CSCL 06/5

A survey was conducted to determine if training in high-altitude physiology should be required for civilian pilots; what the current status of such training was; and, if required, what should be included in an ideal curriculum. The survey included a review of ASRS and NTSB accidents/incidents where high altitude was a contributing factor, current FARs, the Airman's Information Manual, and military training courses. In addition, representatives of pilot and flight attendant unions, airlines, airframe manufacturers, the armed services, NBAA, AOPA, flight schools, and universities were interviewed. And, an expert in the field was identified and asked to write a discussion paper for inclusion in the report. The survey determined that there is a need for such training. It was also found that current training practices are not uniform and sometimes do not even address those subjects required by Federal Aviation Regulations. GRA

N92-13572# Naval Aerospace Medical Research Lab., Pensacola, FL.
BIBLIOGRAPHY OF SCIENTIFIC PUBLICATIONS 1978-1990
K. S. Mayer Sep. 1991 38 p
(AD-A241297) Avail: NTIS HC/MF A03 CSCL 05/2

This publication lists citations of all unclassified research reports, special reports, monographs, joint reports, journal articles, and proceedings that were published by the Naval Aerospace Medical Laboratory during calendar years 1978 through 1990. GRA

N92-13573# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Armstrong Lab.
REAL-EAR ATTENUATION TESTING SYSTEM (RATS) Final Report, Dec. 1989 - Dec. 1990
Nancy K. Allen Jan. 1991 55 p
(AD-A241475; AL-TR-1991-0073) Avail: NTIS HC/MF A04 CSCL 06/5

Air Force personnel are often exposed to high levels of noise. One of the hazards of working in an intense noise environment is the risk of hearing impairment. To minimize the adverse effects of high noise levels, the Air Force has set policies outlined in AF Regulation 161-35, Hazardous Noise Exposure (1), to implement a hearing conservation and monitoring program for personnel working in hazardous noise environments. There are three methods of protecting individuals from hazardous noise: providing engineering controls, administrative controls, and hearing protectors. Engineering controls provide noise control measures in the design of buildings, facilities, and weapon systems. When engineering controls are not feasible or do not provide the complete solution, administrative controls can be implemented to limit the work time in the noise environment. GRA

N92-13574# Army Research Inst. of Environmental Medicine, Natick, MA.
VOLUNTARY CONSUMPTION OF A LIQUID CARBOHYDRATE SUPPLEMENT BY SPECIAL OPERATIONS FORCES DURING A HIGH ALTITUDE COLD WEATHER FIELD TRAINING EXERCISE Final Report, 19 Mar. 1989 - 1 Sep. 1990
T. E. Jones, R. W. Hoyt, C. J. Baker, C. B. Hintlian, and P. S. Walczak 1 Sep. 1990 123 p
(AD-A241769; USARIEM-T20-90) Avail: NTIS HC/MF A06 CSCL 06/8

A six day field test was conducted to measure the energy expenditures, activity levels and nutrient intakes of unsupported soldiers consuming the Ration, Lightweight (RLW) with a liquid carbohydrate (CHO) supplement during a strenuous field training exercise at high altitude. Ten soldiers (+/- SD; age 32 +/- 5yrs, wt 81.2 +/- 9.7 kg, and body fat 18.9 +/- 8.3 percent were required to consume the RLW and a liquid CHO supplement exclusively for six days. Body comparison measurements (anthropometry and hydrostatic weighing), activity levels

(ambulatory monitors), food and water intakes (log book technique), and ration acceptability (post study questionnaire) were recorded. Mean caloric intake for the six day study was 2467 +/- 384 kcal/day (12 percent protein, 34 percent fat and 54 percent CHO). Mean energy expenditure using the intake/balance method was 4294 +/- 1276 kcal/day. Body weight loss averaged 1.7 +/- 7 kg with 35 percent from fat free mass and 65 percent from fat mass. Total fluid intake was 3.6 L/day. Carbohydrate intakes from the RLW and CHO supplement were 229 +/- 55(916 kcal/day) and 103 +/- 44 g/day (412 kcal/day), respectively. GRA

N92-13575# Army Research Inst. of Environmental Medicine, Natick, MA.
THE USE OF HYPOXIC AND CARBON DIOXIDE SENSITIVITY TESTS TO PREDICT THE INCIDENCE AND SEVERITY OF ACUTE MOUNTAIN SICKNESS IN SOLDIERS EXPOSED TO AN ELEVATION OF 3800 METERS Final Report, Apr. - Aug. 1990
Charles S. Fulco, Laurie A. Trad, Vincent A. Forte, Jr., Julio Gonzalez, and Eugene J. Iwanyk 20 Feb. 1991 32 p
(AD-A241792; USARIEM-T7-91) Avail: NTIS HC/MF A03 CSCL 06/5

Acute mountain sickness (AMS) is characterized by headache, nausea, and dizziness with individual differences occurring susceptibility. At any altitude, there will be individuals who will show little or no symptoms while others will be severely incapacitated. Previous studies have shown that individuals with no symptoms of AMS tend to ventilate more than those who develop severe symptoms. The main objective of this study was to determine if susceptibility to AMS can be predicted from ventilatory responses to breathing hypoxic and carbon dioxide gas mixtures for 7 to 10 minutes prior to an altitude exposure. Another objective was to determine if there was a difference between cigarette smokers and nonsmokers in susceptibility. Forty-seven soldiers (25 smokers and 22 nonsmokers) performed an isocapnic hypoxic ventilatory response (HVR) test and a hypercapnic ventilatory response (HCVR) test at Ft. Riley, KS (450 m) prior to being deployed to the Santa Lucia Base Camp, Potosi Bolivia (3500 to 4050 m). AMS symptoms were assessed in Bolivia by the self-administered Environmental Symptoms Questionnaire during the first two days of exposure. GRA

N92-13549# School of Aerospace Medicine, Brooks AFB, TX.
INTRODUCTION TO AEROSPACE NEUROLOGY
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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N92-13553# School of Aerospace Medicine, Brooks AFB, TX.
UNEXPLAINED LOSS OF CONSCIOUSNESS
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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N92-13560# School of Aerospace Medicine, Brooks AFB, TX.
SEQUELAE OF HEAD INJURY
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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N92-13562# School of Aerospace Medicine, Brooks AFB, TX.
SELECTED CONCERNS/EXCESSIVE DAYTIME SLEEPINESS
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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N92-13563# School of Aerospace Medicine, Brooks AFB, TX.
MULTIPLE SCLEROSIS AND OPTIC NEURITIS
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 10 p (For primary document see N92-13547 04-51)
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N92-13564# School of Aerospace Medicine, Brooks AFB, TX.
HEADACHE
Marc S. Katchen *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
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N92-13565# School of Aerospace Medicine, Brooks AFB, TX. Aerospace Clinical Psychology Function.
MISHAP AFTERCARE
John C. Patterson *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N92-13576*# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
ACQUISITION AND PRODUCTION OF SKILLED BEHAVIOR IN DYNAMIC DECISION-MAKING TASKS: MODELING STRATEGIC BEHAVIOR IN HUMAN-AUTOMATION INTERACTION: WHY AND AID CAN (AND SHOULD) GO UNUSED Semiannual Status Report
Alex Kirlik Sep. 1991 35 p
(Grants NAG2-656; NAG2-195)
(NASA-CR-188962; NAS 1.26:188962; TR-91-5) Avail: NTIS HC/MF A03 CSCL 05I

Advances in computer and control technology offer the opportunity for task-offload aiding in human-machine systems. A task-offload aid (e.g., an autopilot, an intelligent assistant) can be selectively engaged by the human operator to dynamically delegate tasks to an automated system. Successful design and performance prediction in such systems requires knowledge of the factors influencing the strategy the operator develops and uses for managing interaction with the task-offload aid. A model is presented that shows how such strategies can be predicted as a function of three task context properties (frequency and duration of secondary tasks and costs of delaying secondary tasks) and three aid design properties (aid engagement and disengagement times, aid performance relative to human performance). Sensitivity analysis indicates how each of these contextual and design factors affect the optimal aid aid usage strategy and attainable system performance. The model is applied to understanding human-automation interaction in laboratory experiments on human supervisory control behavior. The laboratory task allowed subjects freedom to determine strategies for using an autopilot in a dynamic, multi-task environment. Modeling results suggested that many subjects may indeed have been acting appropriately by not using the autopilot in the way its designers intended. Although autopilot function was technically sound, this aid was not designed with due regard to the overall task context in which it was placed. These results demonstrate the need for additional research on how people may strategically manage their own resources, as well as those provided by automation, in an effort to keep workload and performance at acceptable levels. Author

N92-13577# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
UNALERTED AIR-TO-AIR VISUAL ACQUISITION
J. W. Andrews 26 Nov. 1991 39 p
(Contracts DTFA01-85-Z-02015; F19628-90-C-0002)
(ATC-152; DOT/FAA/PM-87/34) Avail: NTIS HC/MF A03

A series of flight tests were flown to measure pilot air-to-air visual acquisition performance for pilots employing unalerted visual search. Twenty-four general aviation subject pilots flew a cross-country route while an intercepting aircraft was controlled to produce three intercepts with altitude separation of 500 feet. Pilots received no traffic advisory information to alert them to the possible presence of the intercepting aircraft. Results were analyzed to estimate the instantaneous rate of visual acquisition that can be used to predict pilot performance under a range of conditions.
Author

N92-13578# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
SPATIAL DISORIENTATION RESEARCH ON THE DYNAMIC ENVIRONMENTAL SIMULATOR (DES) Final Report, Oct. 1988 - Dec. 1989
William B. Albery Oct. 1990 10 p
(AD-A241203; AAMRL-SR-90-513) Avail: NTIS HC/MF A02 CSCL 06/5

Spatial Disorientation (SD) is a serious human factors problem in both the Air Force and Navy. Over 70 Class A mishaps involving nearly total loss of an aircraft or death of the pilot have been attributed to SD in the U.S. Air Force alone since 1980. Many of these SD related fatalities involve low-level turning mishaps in which the pilot is moving his head and the aircraft is at greater than 1G. The G excess illusion, and altered perception of one's attitude when G 1, is a potential player in many of these low-level turning mishaps. The purpose of this study was to assess the potential of the Dynamic Environment Simulators, a 20 ft radius, dual-gimballed, human centrifuge to generate vestibular related SD illusions, especially, the G-excess illusion. GRA

N92-13579# Navy Personnel Research and Development Center, San Diego, CA.
A COMPARISON OF FOUR TYPES OF FEEDBACK DURING COMPUTER-BASED TRAINING (CBT)
Michael Cowen Oct. 1991 60 p
(AD-A241626; NPRDC-TR-92-2) Avail: NTIS HC/MF A04 CSCL 12/5

Navy personnel often have difficulty operating the state-of-the-art programmable equipment employed in radar systems, communication systems, and transportation systems. These types of devices tend to be designed without adequate consideration of the user interface. Computer-based training (CBT) systems have been developed to help users overcome difficulties associated with learning how to operate complex devices. An important capability of CBT is feedback that informs users about the correctness of their knowledge of device procedures. Current research in CBT provides little guidance as to when feedback should be provided and how to design feedback content. An experimental CBT lesson on how to operate a military phone system was administered to 80 Navy students. The lesson was presented individually on a microcomputer and consisted of an introduction, a practice, and performance test. During practice, each treatment group received one of four types of feedback. The computer provided feedback either immediately following an error or at the end of the button-pushing of the to-be-learned sequence. Feedback consisted of the correct response or a wrong indication. All the CBT treatment groups outperformed a no-treatment control group. The treatment group who received delayed feedback performed significantly better on the performance test than those who received immediate feedback. Delaying the feedback was beneficial during CBT because it aids in the development of a usable device schema. GRA

N92-13580# University of Southern California, Los Angeles. Dept. of Psychology.
A BIOLOGICAL NEURAL NETWORK ANALYSIS OF LEARNING AND MEMORY Final Report, 1 Feb. 1988 - 31 Jan. 1991
Richard F. Thompson 9 Oct. 1991 6 p
(Contract N00014-88-K-0112)
(AD-A241837) Avail: NTIS HC/MF A02 CSCL 05/8

The basic goal of our research program is to localize and analyze processes and mechanisms of memory formation, storage, and retrieval in the mammalian brain. We focus on associative learning and memory of elementary adaptive, skilled movements, using classical conditioning of discrete movement (e.g., eyeblink, limb flexion). In this contract period we have developed extensive evidence for the following: (1) using a tone conditioned stimulus (CS)- the CS pathway involves the pontine nuclei and their mossy fiber projections to the cerebellum, (2) the unconditioned stimulus (US) reinforcing pathway involves the dorsal accessory olive and its climbing fiber projections to the cerebellum, (3) the CR pathway projects from the interpositus nucleus of the cerebellum to the red nucleus, and (4) the memory trace appears to be formed in the cerebellum. Our computational/mathematical work involves a neural network model of the cerebellum and its associated brain stem circuitry, constrained by the biological properties of this neural system, and is increasingly successful in accounting for the properties of learning and memory of skilled movements. GRA

N92-13548# Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).
THE PILOT FLIGHT SURGEON BOND
J. R. Galle-Tessonneau *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 5 p (For primary document see N92-13547 04-51)
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N92-13550# Institute of Aviation Medicine, Oslo (Norway).
AVIATION PSYCHOLOGY IN THE OPERATIONAL SETTING
Grete Myhre *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 4 p (For primary document see N92-13547 04-51)
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N92-13551# Jones (David R.), San Antonio, TX.
PSYCHIATRIC DISORDERS IN AEROSPACE MEDICINE: SIGNS, SYMPTOMS, AND DISPOSITION
David R. Jones *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-13552# Letterman Army Inst. of Research, San Francisco, CA.
PSYCHOLOGICAL FACTORS INFLUENCING PERFORMANCE AND AVIATION SAFETY, 1
James J. Picano *In* AGARD, Neurological, Psychiatirc and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-13554# Letterman Army Inst. of Research, San Francisco, CA.
ASSESSING ADAPTABILITY FOR MILITARY AERONAUTICS
James J. Picano *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-13555# Institute of Aviation Medicine, Oslo (Norway).
DOMESTIC PROBLEMS AND AVIATOR FAMILY SUPPORT

Grete Myhre *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 3 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-13556# Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).
FEAR OF FLYING
J. R. Galle-Tessonneau *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 6 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-13557# School of Aerospace Medicine, Brooks AFB, TX. Aerospace Clinical Psychology Function.
PSYCHOMETRIC EVALUATION TECHNIQUES IN AEROSPACE MEDICINE
John C. Patterson *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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N92-13558# Letterman Army Inst. of Research, San Francisco, CA.
PSYCHOLOGICAL FACTORS INFLUENCING PERFORMANCE AND AVIATION SAFETY, 2
James J. Picano *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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N92-13559# Jones (David R.), San Antonio, TX.
PSYCHIATRIC REACTIONS TO COMMON MEDICATIONS
David R. Jones *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-13561# School of Aerospace Medicine, Brooks AFB, TX.
THE FAILING AVIATOR
John C. Patterson *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 2 p (For primary document see N92-13547 04-51)
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N92-13566# Jones (David R.), San Antonio, TX.
MEDICAL OR ADMINISTRATIVE? PERSONALITY DISORDERS AND MALADAPTIVE PERSONALITY TRAITS IN AEROSPACE MEDICAL PRACTICE
David R. Jones and John C. Patterson (School of Aerospace Medicine, Brooks AFB, TX.) *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine Sep. 1991 4 p Submitted for publication (For primary document see N92-13547 04-51)
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54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-13581*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RISKS, DESIGNS, AND RESEARCH FOR FIRE SAFETY IN SPACECRAFT
Robert Friedman, Kurt R. Sacksteder, and David Urban (Sverdrup Technology, Inc., Brook Park, OH.) 1991 22 p Presented at the Fall Meeting of the National Fire Protection Association, Inc., Montreal, Quebec, 19 Nov. 1991
(Contract NAS3-25266)
(NASA-TM-105317; E-6672; NAS 1.15:105317) Avail: NTIS HC/MF A03 CSCL 05H

Current fire protection for spacecraft relies mainly on fire prevention through the use of nonflammable materials and strict storage controls of other materials. The Shuttle also has smoke detectors and fire extinguishers, using technology similar to aircraft practices. While experience has shown that the current fire protection is adequate, future improvements in fire safety technology to meet the challenges of long duration space missions, such as the Space Station Freedom, are essential. All spacecraft fire protection systems, however, must deal with the unusual combustion characteristics and operational problems in the low gravity environment. The features of low gravity combustion that affect spacecraft fire safety, and the issues in fire protection for Freedom that must be addressed eventually to provide effective and conservative fire protection systems are discussed. Author

N92-13582# University of North Texas, Denton. Dept. of Computer Information Systems and Management Sciences.
SURVIVAL ANALYSIS: A TRAINING DECISION APPLICATION
Interim Technical Report, Jun. 1990 - Mar. 1991
Julia A. Stephenson Aug. 1991 18 p
(AD-A240808; AL-TP-1991-0003) Avail: NTIS HC/MF A03 CSCL 05/9

The life of a task in an airman's inventory of tasks performed has not been investigated. How long a task remains (survives) in an individual's task inventory is of interest for training purposes. Survival analysis can possibly be used to measure task survivability. However, survival analysis uses longitudinal data whereas the USAF Occupational Survey Program captures vertical data (i.e., a snapshot is taken of the work force at one moment in time). Nonetheless, because survival analysis can incorporate both time and censored data, it could provide useful information about task survivability. In this effort, a task survival data base was modeled by combining both occupational survey data and known attribution data. Survival analysis functions were then generated. Results show both that survival analysis can be used to study task survivability and that this approach produces accurate estimates of task life. GRA

N92-13583# Anacapa Sciences, Inc., Fort Rucker, AL.
TASK ANALYSIS AND WORKLOAD PREDICTION MODEL OF THE MH-60K MISSION AND A COMPARISON WITH UH-60A WORKLOAD PREDICTIONS. VOLUME 1: SUMMARY REPORT
Interim Report, Dec. 1988 - Apr. 1990
Carl R. Bierbaum and David B. Hamilton Oct. 1990 56 p
(Contract MDA903-87-C-0523)
(AD-A241204; ASI90-328-90-II-Vol-1; ARI-RR-1576-Vol-1) Avail: NTIS HC/MF A04 CSCL 05/8

A mission scenario was used to conduct a comprehensive task analysis for MH-60K operations. The analysis used a top-down approach to identify the phases, functions, and tasks for the mission. Five phases, 15 segments, 71 functions, and 230 tasks were identified. Researchers identified the crewmember performing each task, and derived estimates of the sensory, cognitive, and psychomotor workload associated with each task. Estimates of

the task durations also were derived. The mission/task/workload analysis data were used to develop a computer model of workload for MH-60K crewmembers. The model used a bottom-up approach to build mission functions from tasks and mission segments from functions. Decision rules were written to specify the procedure for combining the tasks into functions and the functions into segments. The model permitted an analysis of total workload experienced by the pilot and copilot in the performance of both sequential and concurrent tasks. The predicted workload for the MH-60K pilot and copilot was compared to the UH-60A baseline workload prediction to determine the impact of the MH-60K advanced technology. The comparison indicated very little difference in the predicted workload for the pilot and indicated a lower predicted workload for the copilot in the MH-60K. GRA

N92-13584# Massachusetts Inst. of Tech., Cambridge.
HUMAN FACTORS ENGINEERING IN SONAR VISUAL DISPLAYS M.S. Thesis
Lawrence F. Galvin Aug. 1991 136 p
(Contract N00123-89-G-0580)
(AD-A241327) Avail: NTIS HC/MF A07 CSCL 13/2

Undersea technology is on the verge of equipping remotely operated vehicle (ROV) pilots with a three-dimensional (3-D), real-time display incorporating data from a wide variety of sensors including sonar (sound navigation and ranging), cameras, and lasers. Effective collection, computation, and presentation of this data to the pilot in a single display presents hardware, software and human factors problems. This thesis focuses on human factors issues associated with the display of information which could enhance the pilot's efficiency of performance. Background information on human factors engineering, 3-D computer graphics displays, and application of the 3-D perspective display precede the details of the experiment. Five specific display enhancements tested include altering the displayed field of view, providing a screen grid, displaying the current range to the target of interest, using a vertical color scheme, and controlling the display update rate. Seven tests measure the effects of these display enhancements on the simulated piloting of an ROV. The effects of the ROV simulation and operator learning curves are removed to compare performance change due to the various enhancements directly. Operator comments during and after testing as well as test monitor/author observations provide insight into the experiment. Test result implications for system design trade-offs are discussed in detail. GRA

N92-13585# Army Natick Research and Development Command, MA.
PROCEEDINGS OF THE 1ST INTERNATIONAL SYMPOSIUM ON NONLINEAR OPTICAL POLYMERS FOR SOLDIER SURVIVABILITY Final Report
Sep. 1990 117 p Symposium held in Natick, MA, 13-14 Jun. 1989
(AD-A241335; NATICK/TR-90/028) Avail: NTIS HC/MF A06 CSCL 06/5

Thirteen abstracts and 9 papers were presented at the First International Symposium on Nonlinear Optical Polymers, held 13-14 June 1989 at the U.S. Army Natick Research Development and Engineering Center, Natick, MA. The mission of the U.S. Army Natick Research Development and Engineering Center is to provide personal protection for the soldier against battlefield threats or those encountered in training. Recently a new threat has developed through the use of low power lasers in rangefinders and target designators and potential tunable weapons systems. Coherent radiation from these devices is capable of inflicting severe damage to the retina of the eye. One mode of protecting against such threats involves the development of nonlinear optical polymers which permit the transmission of visible light at ambient intensities but will reversibly block visible and near infrared radiation at intensities harmful to the eye. GRA

N92-13586# Wright State Univ., Dayton, OH. Human Factors Engineering.
TOWARD A MODEL OF KNOWLEDGE REPRESENTATION AND A COMPARATIVE ANALYSIS OF KNOWLEDGE REPRESENTATION MEASUREMENT TECHNIQUES Interim Report, 1 Jul. 1990 - 1 Jun. 1991
Richard J. Koubek and Daniel N. Mountjoy 1 Sep. 1991 54 p
(Contract N00014-90-J-1256)
(AD-A241400) Avail: NTIS HC/MF A04 CSCL 05/8

This research attempts to develop and validate a proposed model of human knowledge representation. Based on an extensive literature review, a battery of available knowledge representation measurement techniques was selected to detect the representation differences between two experience level groups in the domain of clerical work. The techniques employed were card sorting, hierarchical clustering analysis, repertory grid, multidimensional scaling, Pathfinder, and pairwise similarity ratings. Results validate the existence of all model dimensions. Two dimensions were determined to be affected by experience level. Post-hoc analysis revealed that an additional dimension, Representation Complexity, is a function of experience level differences, and should therefore be included in future model development. Furthermore, the capabilities of the various measurement techniques differed. Specifically, hierarchical clustering analysis was the most effective technique for detecting differences in representations between experience level groups. GRA

N92-13587# EEG Systems Lab., San Francisco, CA.
NEURO-TRIGGERED TRAINING Interim Report, 1 Apr. 1990 - 30 Mar. 1991
Alan S. Gevins and Brian A. Cutillo 30 Apr. 1991 15 p
(Contract F49620-90-C-0026)
(AD-A241511; AFOSR-91-0784TR) Avail: NTIS HC/MF A03 CSCL 05/8

Cortical neuroelectric patterns during a working memory task differed from a control task during two of four split-second intervals when access to the contents of working memory is assumed to take place. Prefrontal cortical areas were prominent among those differentially activated by working memory in these two intervals, which included a prestimulus preparatory interval and a late poststimulus response-inhibition interval. By contrast, patterns were similar between conditions during an early poststimulus interval and during a response interval, when the predominant activity was related to stimulus encoding or response execution. These results suggest that working memory is a dynamic process embodied in neuroelectric activity patterns distributed across the neural areas involved in performing a particular task. The active aspect of short-term memory, termed working memory by A. Baddeley and co-workers, provides the basis for consciously directed perception, cognition and action, attentional programs, and extended logical and linguistic operations. GRA

N92-13845*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
ANALYSIS OF SIMULATED IMAGE SEQUENCES FROM SENSORS FOR RESTRICTED-VISIBILITY OPERATIONS
Rangachar Kasturi *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 125-128 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N92-13588*# National Aeronautics and Space Administration, Washington, DC.
FOURTH SYMPOSIUM ON CHEMICAL EVOLUTION AND THE ORIGIN AND EVOLUTION OF LIFE Abstracts Only
Robert A. Wharton, Jr., ed., Dale T. Andersen, ed., Sara E. Bzik,

ed. (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.), and John D. Rummel, ed. Oct. 1991 129 p Symposium held at Moffett Field, CA, 24-27 Jul. 1990
(NASA-CP-3129; NAS 1.55:3129) Avail: NTIS HC/MF A07 CSCL 06C

This symposium was held at the NASA Ames Research Center, Moffett Field, California, July 24-27, 1990. The NASA exobiology investigators reported their recent research findings. Scientific papers were presented in the following areas: cosmic evolution of biogenic compounds, prebiotic evolution (planetary and molecular), early evolution of life (biological and geochemical), evolution of advanced life, solar system exploration, and the Search for Extraterrestrial Intelligence (SETI). For individual titles, see N92-13589 through N92-13672.

N92-13589*# Massachusetts Univ., Amherst.
THE CHEMISTRY OF DENSE INTERSTELLAR CLOUDS Abstract Only
W. M. Irvine *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 15 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The basic theme of this program is the study of molecular complexity and evolution in interstellar and circumstellar clouds incorporating the biogenic elements. Recent results include the identification of a new astronomical carbon-chain molecule, C4Si. This species was detected in the envelope expelled from the evolved star IRC+10216 in observations at the Nobeyama Radio Observatory in Japan. C4Si is the carrier of six unidentified lines which had previously been observed. This detection reveals the existence of a new series of carbon-chain molecules, C sub n Si (n equals 1, 2, 4). Such molecules may well be formed from the reaction of Si(+) with acetylene and acetylene derivatives. Other recent research has concentrated on the chemical composition of the cold, dark interstellar clouds, the nearest dense molecular clouds to the solar system. Such regions have very low kinetic temperatures, on the order of 10 K, and are known to be formation sites for solar-type stars. We have recently identified for the first time in such regions the species of H2S, NO, HCOOH (formic acid). The H2S abundance appears to exceed that predicted by gas-phase models of ion-molecule chemistry, perhaps suggesting the importance of synthesis on grain surfaces. Additional observations in dark clouds have studied the ratio of ortho- to para-thioformaldehyde. Since this ratio is expected to be unaffected by both radiative and ordinary collisional processes in the cloud, it may well reflect the formation conditions for this molecule. The ratio is observed to depart from that expected under conditions of chemical equilibrium at formation, perhaps reflecting efficient interchange between cold dust grains in the gas phase. Author

N92-13590*# Molecular Research Inst., Palo Alto, CA.
THEORETICAL STUDIES OF THE EXTRATERRESTRIAL CHEMISTRY OF BIOGENIC ELEMENTS AND COMPOUNDS Abstract Only
D. J. DeFrees *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 16 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Organic compounds, molecules related to those in living systems, are found in many different extraterrestrial environments. The study of organic astrochemistry is important to exobiology both because it demonstrates the ubiquity of processes which led to life on Earth and because the dust clouds where molecules are found are analogs of the solar nebula from which the Earth formed. In the long chain of events leading from the Big Bang, and a universe composed of atomic hydrogen and helium, to the emergence of life on Earth, molecular interstellar clouds are an early link, the most primitive objects which display any significant organic chemistry. One such cloud was the direct precursor to the solar system and to all objects which it contains. Theoretical methods are ideally suited to studying interstellar cloud chemistry. They have been applied to determine spectroscopic constants of candidate interstellar molecules, mechanisms of ion-molecule reactions, and composition of dust grains. Accurate predictions of rotational constants and dipole moments of long-chain carbon molecules HC13N, HC15N, and C5O have been made to aid in determining the size limit of gas-phase interstellar molecules. Models of gas-phase interstellar chemistry use reaction rate constants measured at room temperature and extrapolated to interstellar temperatures. The temperature dependence of NH3(+)+H2 yields NH4(+)+H is anomalous, however, with a minimum rate at about 100K, casting doubt on the extrapolation procedures. The temperature dependence has now been explained. Author

N92-13591*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MEASUREMENT OF THE SPECTRAL SIGNATURE OF SMALL CARBON CLUSTERS AT NEAR AND FAR INFRARED WAVELENGTHS Abstract Only
J. Tarter and R. Saykally (California Univ., Berkeley. Lawrence Berkeley Lab.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 17 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

A significant percentage of the carbon inventory of the circumstellar and interstellar media may be in the form of large refractory molecules (or small grains) referred to as carbon clusters. At the small end, uneven numbers of carbon atoms seem to be preferred, whereas above 12 atoms, clusters containing an even number of carbon atoms appear to be preferred in laboratory chemistry. In the lab, the cluster C-60 appears to be a particularly stable form and has been nicknamed Bucky Balls because of its resemblance to a soccer ball and to geodesic domes designed by Buckminster Fuller. In order to investigate the prevalence of these clusters, and their relationship to the polycyclic aromatic hydrocarbons (PAHs) that have become the newest focus of IR astronomy, it is necessary to determine the spectroscopic characteristics of these clusters at near and far infrared wavelengths. Described here is the construction of a near to far IR laser magnetic resonance spectrometer that has been built at the University of California Berkeley in order to detect and characterize these spectra. The equipment produces carbon clusters by laser evaporation of a graphitic target. The clusters are then cooled in a supersonic expansion beam in order to simulate conditions in the interstellar medium (ISM). The expansion beam feeds into the spectrometer chamber and permits concentrations of clusters sufficiently high as to permit ultra-high resolution spectroscopy at near and far IR wavelengths. The first successful demonstration of this apparatus occurred last year when the laboratory studies permitted the observational detection of C-5 in the stellar outflow surrounding IRC+10216 in the near-IR. Current efforts focus on reducing the temperature of the supersonic expansion beam that transport the C clusters evaporated from a graphite target into the spectrometer down to temperatures as low as 1 K. Author

N92-13592*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LABORATORY AND OBSERVATIONAL STUDY OF THE INTERRELATION OF THE CARBONACEOUS COMPONENT OF INTERSTELLAR DUST AND SOLAR SYSTEM MATERIALS Abstract Only
L. J. Allamandola, S. A. Sanford, W. A. Schutte, and A. G. G. M. Tielens *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 18 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

By studying the chemical and isotopic composition of interstellar ice and dust, one gains insight into the composition and chemical evolution of the solid bodies in the solar nebula and the nature of the material subsequently brought into the inner part of the solar system by comets and meteorites. It is now possible to spectroscopically probe the composition of interstellar ice and dust in the mid-infrared, the spectral range which is most diagnostic of

fundamental molecular vibrations. We can compare these spectra of various astronomical objects (including the diffuse and dense interstellar medium, comets, and the icy outer planets and their satellites) with the spectra of analogs we produce in the laboratory under conditions which mimic those in these different objects. In this way one can determine the composition and abundances of the major constituents of the various ices and place general constraints on the types of organics coating the grains in the diffuse interstellar medium. In particular we have shown the ices in the dense clouds contain H2O, CH3OH, CO, perhaps some NH3 and H2CO, we well as nitriles and ketones or esters. Furthermore, by studying the photochemistry of these ice analogs in the laboratory, one gains insight into the chemistry which takes place in interstellar/precometary ices. Chemical and spectroscopic studies of photolyzed analogs (including deuterated species) are now underway. The results of some of these studies will be presented and implications for the evolution of the biogenic elements in interstellar dust and comets will be discussed.
Author

N92-13593*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
QUANTIFICATION OF UV STIMULATED ICE CHEMISTRY: CO AND CO2 Abstract Only
V. G. Anicich, T. Arakelian, and M. S. Hanner *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 19 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Recent laboratory experiments are presented that show that during photolysis of the pure ices there is evidence of the interconversion of CO to CO2 and CO2 to CO using Lyman alpha (1216A) radiation. In addition, there is a substantial amount of another substance being produced. This substance is evident by its infrared absorption peak at 2235 cm(-1). It is believed that this new peak is due to carbon suboxide, C3O2. CO and CO2 have already been detected in comets, and C3O2 has been suggested as a cometary from radiation of CO. Comparisons are made between our results at 1215A and proton radiation experiments and radiation at other wavelengths. The suggestion is that the processing of ices is energy dependent, i.e., dependent on the type of radiation. Several difficult problems have to be solved before these radiation conversions can be quantified. The steps that we are taking to quantify the kinetics are discussed. Author

N92-13594*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
VOLATILES IN INTERPLANETARY DUST PARTICLES AND AEROGELS Abstract Only
E. K. Gibson, Jr. and C. P. Harmetz *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 20 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Volatiles measured in 25 interplanetary dust particles (IDPs) are a mixture of both indigenous materials and contaminants associated with the collection and processing of the ODPs prior to analysis. Most IDPs have been collected in the stratosphere using a silicone oil/freon mixture (20:1 ratio) coated on collector plates. Studies have shown that silicone oil, freon and hexane residues remain with the ODPs, despite attempts to clean the IDPs. Analysis of the IDPs with the LMMS-technique produces spectra with a mixture of indigeneous and contaminants components. The contamination signal can be identified and removed; however, the contamination signal may obscure some of the indigeneous component's signal. Employing spectra stripping techniques, the indigenous volatile constituents associated with the IDPs can be identified. Volatiles are similar to those measured in CI or CM carbonaceous chondrites. Collection of IDPs in low-Earth orbit utilizing a Cosmic Dust Collection Facility attached to Space Station Freedom has been proposed. The low-density material aerogel has been proposed as a collection substrate for IDPs. Our studies have concentrated on identifying volatile contaminants that are associated with aerogel. We have found that solvents used for the preparation of aerogel remain in aerogel and methods must be developed for removing the entrapped solvents before aerogels can be used for an IDP collection substrate.
Author

N92-13595*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ISOTOPIC COMPOSITION OF MURCHISON ORGANIC COMPOUNDS: INTRAMOLECULAR CARBON ISOTOPE FRACTIONATION OF ACETIC ACID. SIMULATION STUDIES OF COSMOCHEMICAL ORGANIC SYNTHESES Abstract Only
G. U. Yuen, J. R. Cronin, N. E. Blair (North Carolina State Univ., Raleigh.), D. J. DesMarais, and S. Chang *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 21 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Recently, in our laboratories, samples of Murchison acetic acid were decarboxylated successfully and the carbon isotopic composition was measured for the methane released by this procedure. These analyses showed significant differences in C-13/C-12 ratios for the methyl and carboxyl carbons of the acetic acid molecule, strongly suggesting that more than one carbon source may be involved in the synthesis of the Murchison organic compounds. On the basis of this finding, laboratory model systems simulating cosmochemical synthesis are being studied, especially those processes capable of involving two or more starting carbon sources.
Author

N92-13596*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTACT CAPTURE OF COSMIC DUST Abstract Only
P. Tsou *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 25 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The focus of this development effort is to capture dust particles at hypervelocities intact and unmelted in order to preserve volatile organics. At the same time, the capture process must minimize any organic elemental or compound contamination to prevent any compromise of exobiological analyses. Inorganic silicate aerogel has been developed as a successful capture medium to satisfy both requirements of intact capture and minimal organic contamination. Up to 6 km/s, silicate projectiles from a few microns up to 100 microns have been captured intact without any melting and with minimal loss of mass. Carbon in silicate aerogel can be reduced to less than 1 part in 1000 and hydrogen 3 parts in 1000 when baked in air. Under controlled inert gas environments, additional hydrocarbon reduction can be achieved.
Author

N92-13597*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXOBIOLOGICAL IMPLICATIONS OF DUST AGGREGATION IN PLANETARY ATMOSPHERES: AN EXPERIMENT FOR THE GAS-GRAIN SIMULATION FACILITY Abstract Only
J. L. Huntington, D. E. Schwartz, and J. R. Marshall (Arizona State Univ., Tempe.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 26 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The Gas-Grain Simulation Facility (GGSF) will provide a microgravity environment where undesirable environmental effects are reduced, and thus, experiments involving interactions between small particles and grains can be more suitably performed. Slated for flight aboard the Shuttle in 1992, the ESA glovebox will serve as a scientific and technological testbed for GGSF exobiology experiments as well as generating some basic scientific data. Initial glovebox experiments will test a method of generating a stable, mono-dispersed cloud of fine particles using a vibrating sprinkler system. In the absence of gravity and atmospheric turbulence, it will be possible to determine the influence of interparticle forces in controlling the rate and mode of aggregation. The experimental

chamber can be purged of suspended matter to enable multiple repetitions of the experiments. Of particular interest will be the number of particles per unit volume of the chamber, because it is suspected that aggregation will occur extremely rapidly if the number exceeds a critical value. All aggregation events will be recorded on high-resolution video film. Changes in the experimental procedure as a result of surprise events will be accompanied by real-time interaction with the mission specialist during the Shuttle flight. Author

N92-13598*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STABLE CARBON ISOTOPE MEASUREMENTS USING LASER SPECTROSCOPY Abstract Only
T. B. Sauke and J. F. Becker (San Jose State Univ., CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 27 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The 2300 cm(exp -1) spectral region is especially interesting because (12)CO2 and (13)CO2 bands overlap in such a way that their rotational lines have approximately equal absorbance at the anticipated isotopic ratio (approximately 90) of carbon on Earth and Mars. Pairs of rotational lines we have studied are separated by as little as 0.050 cm(exp -1), but are well resolved with a tunable diode laser. Using sophisticated sweep integration and signal averaging techniques, we have measured the stable isotope ratio in carbon dioxide to a precision of better than 1 percent. Author

N92-13599*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PALEOLAKES AND LIFE ON EARLY MARS Abstract Only
M. A. Meyer, Robert A. Wharton, Jr. (Desert Research Inst., Reno, NV.), and C. P. McKay *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 28 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Two distinct directions have begun to elucidate key parameters in the search for extinct life on Mars. Carbonate sediments, deposited about 10,000 years ago in association with biological activity, have been sampled from the paleolake beds of Lake Vanda and Meirs in the McMurdo Dry Valleys in Antarctica. These samples are being analyzed for simple biological signatures that remain in cold and dry paleolake sediments, namely microfossils, percent carbonate, and total organic carbon. Our second initiative is the study of Colour Lake, in the Canadian Arctic, that periodically maintains a perennial ice cover. Physical measurements started this year will be used to determine one end point for ice covered lake environments and will be compared to continuous measurements from Antarctic lakes started in November 1985. Interestingly, Colour Lake also supports benthic mat communities, but the low pH precludes carbonate deposition. This research will broaden our knowledge base for what conditions are necessary for ice covered lake formation and what biological signatures will remain in paleolake deposits. Author

N92-13600*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SUBSURFACE MICROBIAL HABITATS ON MARS Abstract Only
P. J. Boston (Complex Systems Research, Inc., Boulder, CO.) and C. P. McKay *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 29 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

We developed scenarios for shallow and deep subsurface cryptic niches for microbial life on Mars. Such habitats could have considerably prolonged the persistence of life on Mars as surface conditions became increasingly inhospitable. The scenarios rely on geothermal hot spots existing below the near or deep subsurface of Mars. Recent advances in the comparatively new field of deep subsurface microbiology have revealed previously unsuspected rich aerobic and anaerobic microbal communities far below the surface of the Earth. Such habitats, protected from the grim surface conditions on Mars, could receive warmth from below and maintain water in its liquid state. In addition, geothermally or volcanically reduced gases percolating from below through a microbiologically active zone could provide the reducing power needed for a closed or semi-closed microbial ecosystem to thrive. Author

N92-13601*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PALEOBIOMARKERS AND DEFINING EXOBIOLOGY EXPERIMENTS FOR FUTURE MARS EXPERIMENTS Abstract Only
R. L. Mancinelli, L. J. Rothschild, and M. R. White *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 30 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Mars is a cold, dry planet with an oxidizing surface bombarded by ultraviolet and ionizing radiation, making prospects for an extant Mars biota bleak. Yet, it is suggested that early Earth and early Mars were similar enought that life may have evoled on Mars. If life did evolve on Mars, what evidence for its existence might we find? What constitutes a Martian paleobiomarker, and how can we distinguish such a marker from abiotically produced substances? The topics studied to answer this question include carbon and nitrogen cycling, as well as the stability and relative abundance of their intermediates in microbially dominated ecosystems. The microbially dominated ecosystems studied are the crytoendolithic microbial community living within sand rocks, the endoevaporite microbial community living inside salt crystals, and the microbial communities living beneath perennially ice-covered lakes and hypersaline ponds. The nitrogen cycle of these communities ranges from simple, where only assimilation occurs, to the more complex, where a complete cycle occurs. The carbon cycle of these communities appears to be complete. Author

N92-13602*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONCEPTUAL DESIGNS FOR IN SITU ANALYSIS OF MARS SOIL Abstract Only
C. P. McKay, A. P. Zent, and H. Hartman (California Univ., Berkeley.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 31 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

A goal of this research is to develop conceptual designs for instrumentation to perform in situ measurements of the Martian soil in order to determine the existence and nature of any reactive chemicals. Our approach involves assessment and critical review of the Viking biology results which indicated the presence of a soil oxidant, an investigation of the possible application of standard soil science techniques to the analysis of Martian soil, and a preliminary consideration of non-standard methods that may be necessary for use in the highly oxidizing Martian soil. Based on our preliminary analysis, we have developed strawman concepts for standard soil analysis on Mars, including pH, suitable for use on a Mars rover mission. In addition, we have devised a method for the determination of the possible strong oxidants on Mars. Author

N92-13603*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SPECTROSCOPY AND REACTIVITY OF MINERAL ANALOGS OF THE MARTIAN SOIL Abstract Only
A. Banin, J. Orenberg (San Francisco State Univ., CA.), and T. Roush *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 32 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

To answer the question of why life occurred on Earth but not on Mars requires a study of the geochemical and physical aspects of the Martian soil. Some of the best Mars analog mineral models

of the soil have been prepared and justified according to known constraints of chemical composition, reflectance spectroscopy, and chemical reactivity. Detailed laboratory reflectance spectra in the ultraviolet, visible, and near infrared (.30 to 2.5 microns) and the infrared (2.5 to 25 microns) regions have been obtained for the pure candidate minerals and some analog mixtures and compared to Mars reflectance spectra. Modeling of the reflectance spectra from optical constraints determined for the analog minerals has begun and will be interpreted in terms of the effects of particle size variation, component mixing, and soil packing upon remotely sensed reflectance spectra. This has implications not only for Mars, but for other planets and planetoids. The ratio of Fe(II)/Fe(III) in the Martian soil analog materials on spectral reflectance in the visible range has begun, and the results will be evaluated according to conformity with the visible Mars reflectance spectrum. Some initial LR and GEX data have been collected for the mineral samples and their mixtures, which can be compared with the Viking data and interpreted in terms of the redox (Fe(II)/Fe(III) environment.
Author

N92-13604*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MIDINFRARED SPECTRAL INVESTIGATIONS OF CARBONATES: ANALYSIS OF REMOTELY SENSED DATA Abstract Only
T. Roush, J. B. Pollack, and C. P. McKay *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 33 Prepared in cooperation with San Francisco State Univ., CA (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Recent airborne thermal infrared observations of Mars from the Kuiper Airborne Observatory (KAO) have provided evidence for the presence of carbonates, sulfates, and hydrates. Using the optical properties of calcite and anhydrite, it was estimated that CO3's and SO4's constituted about 1 to 3 and 10 to 15 wt. percent, repectively of the materials composing the atmospheric dust. Using the derived value as an estimate of total CO3 abundance, and making an assumption that the CO3's were uniformly distributed within the Martian regolith, it was estimated that such a CO3 reservoir could contain roughly 2 to 5 bars of CO2. While the results indicate that several volatile-bearing materials are present on Mars, the observations from the KAO are inherently limited in their ability to determine the spatial distributions of these materials. However, previous spacecraft observations of Mars provide both the spectral coverage necessary to identify these materials, as well as the potential for investigating their spatial variability. This has prompted us to pursue a reinvestigation of the Mariner 6 and 7 infrared spectrometer and Mariner 9 infrared interferometer spectrometer observations. The former data have been recently made available in digital format and calibration of wavelengths and intensities are almost complete. Additionally, we are pursuing the derivation of optical constants of more appropriate carbonates and sulfates.
Author

N92-13605*# California Univ., Los Angeles.
ISOTOPIC CONSTRAINTS ON THE ORIGIN OF METEORITIC ORGANIC MATTER Abstract Only
J. F. Kerridge *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 37 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Salient features of the isotopic distribution of H, C and N in the organic material found in carbonaceous meteorites are noted. Most organic fractions are strongly enriched in D with respect to the D/H ratio characteristic of H2 in the protosolar system; substantial variations in C-13/C-12 ratio are found among different molecular species, with oxidised species tending to be C-13 enriched relative to reduced species; some homologous series reveal systematic decrease in C-13/C-12 with increasing C number; considerable variation in N-15/N-14 ratio is observed within organic matter, though no systematic pattern to its distribution has yet emerged; no interelement correlations have been observed between isotope enrichments for the different biogenic elements. The isotopic complexity echoes the molecular diversity observed in meteoritic organic matter and suggests that the organic matter was formed by multiple processes and/or from multiple sources. However, existence of a few systematic patterns points towards survival of isotopic signatures characteristic of one or more specific processes. The widespread D enrichment implies either survival of many species of interstellar molecule or synthesis from a reservoir containing a significant interstellar component. Several of the questions raised above can be addressed by more detailed determination of the distribution of the H, C and N isotopes among different well-characterized molecular fractions. Thus, the present study is aimed at discovering whether the different amino acids have comparable D enrichments, which would imply local synthesis from a D-enriched reservoir, or very viable D enrichments, which would imply survival of some interstellar amino acids. The same approach is also being applied to polycyclic aromatic hydrocarbons. Because the analytical technique employed (secondary ion mass spectrometry) can acquire data for all three isotopic systems from each molecular fraction, any presently obscured interelement isotopic correlation should also be revealed, which will aid in identifying pertinent synthetic processes.
Author

N92-13606*# California Inst. of Tech., Pasadena.
KINETIC CONVERSION OF CO TO CH4 IN THE SOLAR SYSTEM Abstract Only
Y. L. Yung, M. Allen, and J. P. Pinto *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 38 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Some of the most interesting chemistry in the Solar System involves changes in the oxidation state of the simple carbon species. The chemical pathways for the conversion of CH4 to CO and CO2 are for the most part known. The reverse process, the reduction of CO to CH4, is, however, poorly understood. This is surprising in view of the importance of the reduction process in the chemistry of the Solar System. Recently we investigated the chemical kinetics of a hitherto unsuspected reaction. It is argued that the formation of the methoxy radical (CH3O) from H+H2CO may play an essential role in the reduction of CO to CH4. The rate coefficient for this reaction has been estimated using the approximate theory of J. Troe and transition state theory. We will discuss the implications of this reaction for the chemistry of CO on Jupiter, in the solar nebula, for interpreting the laboratory experiments of A. Bar-Nun and A. Shaviv and A. Bar-Nun and S. Chang, and for organic synthesis in the prebiotic terrestrial atmosphere. The possible relation of CO reduction in the solar nebula and polyoxymethylene observed in comet Halley will be discussed.
Author

N92-13607*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PRODUCTION OF ORGANIC COMPOUNDS IN PLASMAS: A COMPARISON AMONG ELECTRIC SPARKS, LASER-INDUCED PLASMAS AND UV LIGHT Abstract Only
T. W. Scattergood, C. P. McKay, W. J. Borucki, L. P. Giver, H. VanGhyseghem, J. E. Parris, and S. L. Miller (California Univ., San Diego.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 39 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

In order to study the production of organic compounds in plasmas (and shocks), various mixtures of N2, CH4, and H2, modeling the atmosphere of Titan, were exposed to discrete sparks, laser-induced plasmas (LIP) and ultraviolet light. The yields of HCN and simple hydrocarbons were measured and compared to those calculated from a simple quenched thermodynamic equilibrium model. The agreement between experiment and theory was fair for HCN and C2H2. However, the yields of C2H6 and other hydrocarbons were much higher than those predicted by the model. Our experiments suggest that photolysis by ultraviolet light from the plasma is an important process in the synthesis. This was

confirmed by the photolysis of gas samples exposed to the light, but not to the plasma or shock waves. The results of these experiments demonstrate that, in addition to the well-known efficient synthesis of organic compounds in plasmas, the yields of saturated species, e.g., ethane, may be higher than predicted by theory and that LIP provide a convenient and clean way of simulating planetary lightning and impact plasmas in the laboratory. Author

N92-13608*# Cornell Univ., Ithaca, NY. Lab. for Planetary Studies.

ORGANIC SYNTHESIS IN THE OUTER SOLAR SYSTEM: RECENT LABORATORY SIMULATIONS FOR TITAN, THE JOVIAN PLANETS, TRITON AND COMETS Abstract Only

C. Sagan, W. R. Thompson, B. N. Khare, and C. F. Chyba *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 40-41 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

We tabulate the most abundant gases and their radiation yields, for two experimental pressures: 0.24 mb, more relevant to upper atmosphere excitation, and 17 mb, more relevant to tropospheric, cosmic ray excitation. The yields computed in the 0.24 mb experiment combined with measured electronic fluxes and a simple, eddy diffusion model of Titan's atmosphere predict abundances of detected molecules in agreement with those found by Voyager and for heavier products, in somewhat better agreement with observation than photochemical absolute reaction rate kinetics models. All Voyager organics are accounted for and no detectable products are found that Voyager did not detect. A striking increase of products with multiple bonds is found with decreasing pressure. Hydrocarbon abundances decline slowly with increasing carbon number. Additionally, we list preliminary estimates for the yield of the heteropolymer, which seems to be produced in a quantity comparable (in moles of C+N consumed) to the total amount of gaseous product. The production rate required to sustain Titan's haze against sedimentation also indicates yields of this order. As can be seen from the table, over 10(exp 9) years substantial amounts of these products can accumulate on the surface -- ranging from cm thickness for the (C+N equals 4) species to a meter or more for HCN and C2H2; we also expect a meter or more of tholins. Similar analyses have been or are being done for the Jovian planets and Triton. Charged particle irradiation of hydrocarbon clathrates or mixed hydrocarbon/water ices produces a range of organic products, reddening and darkening of the ices and characteristic infrared spectra. From such spectra, the predicted emission by fine particles in cometary comae well-matches the observed 3.4 micron emission spectra of Comet Halley and other recent comets. Heliocentric evolution of organic emission features in comets is predicted. Organic products of such ice irradiation may account for colors and albedos on some of the satellites in the outer solar system, especially Triton and Pluto, where solid methane is known to exist. Author

N92-13609*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry.

PHOTOCHEMICAL REACTIONS OF CYANOACETYLENE AND DICYANOACETYLENE: POSSIBLE PROCESSES IN TITAN'S ATMOSPHERE

J. P. Ferris and J. C. Guillemin *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 42 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

Titan has an atmosphere which is subject to dramatic chemical evolution due mainly to the dramatic effect of the UV flux from the Sun. The energetic solar photons and other particles are converting the methane-nitrogen atmosphere into the unsaturated carbon compounds observed by the Voyager probes. These same solar photons are also converting some of these unsaturated reaction products into the aerosols observed in the atmosphere which obscure the view of the surface of Titan. In particular, the photochemical reactions of cyanoacetylene, dicyanoacetylene, acetylene and ethylene may result in the formation of the higher hydrocarbons and polymers which result in the aerosols observed in Titan's atmosphere. Polymers are the principal reaction products formed by irradiation of cyanoacetylene and dicyanoacetylene. Irradiation of cyanoacetylene with 185 nm of light also yields 1,3,5-tricyanobenzene while irradiation at 254 nm yields 1,2,4-tricyanobenzene and tetracyano cyclooctatetraenes. Photolyses of mixtures of cyanoacetylene and acetylene yields mono- and di- cyanobenzenes. The 1-Cyanocyclobutene is formed from the photochemical addition of cyanoacetylene with ethylene. The photolysis of dicyanoacetylene with acetylene yields 2,3-dicyano-1,3-butadiene and 1,2-dicyanobenzene. Tetracyano cyclooctatetraene products were also observed in the photolysis of mixtures of dicyanoacetylene and acetylene with 254 nm light. The 1,2-Dicyano cyclobutene is obtained from the photolysis dicyanoacetylene and ethylene. Reaction mechanisms will be proposed to explain the observed photoproducts. Author

N92-13610*# Scripps Clinic and Research Foundation, La Jolla, CA. Dept. of Chemistry.

CONTROLLED EVOLUTION OF AN RNA ENZYME Abstract Only

G. F. Joyce *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 43 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

It is generally thought that prior to the origin of protein synthesis, life on earth was based on self-replicating RNA molecules. This idea has become especially popular recently due to the discovery of catalytic RNA (ribozymes). RNA has both genotypic and phenotypic properties, suggesting that it is capable of undergoing Darwinian evolution. RNA evolution is likely to have played a critical role in the early history of life on earth, and thus is important in considering the possibility of life elsewhere in the solar system. We have constructed an RNA-based evolving system in the laboratory, combining amplification and mutation of an RNA genotype with selection of a corresponding RNA phenotype. This system serves as a functional model of a primitive organism. It can also be used as a tool to explore the catalytic potential of RNA. By altering the selection constraints, we are attempting to modify the substrate specificity of an existing ribozyme in order to develop ribozymes with novel catalytic function. In this way, we hope to gain a better understanding of RNA's catalytic versatility and to assess its suitability for the role of primordial catalyst. All of the RNA enzymes that are known to exist in contemporary biology carry out cleavage/ligation reactions involving RNA substrates. The Tetrahymena ribozyme, for example, catalyzes phosphoester transfer between a guanosine containing and an oligopyrimidine containing substrate. We tested the ability of mutant forms of the Tetrahymena ribozyme to carry out a comparable reaction using DNA, rather than RNA substrate. An ensemble of structural variants of the ribozyme was prepared and tested for their ability to specifically cleave d(GGCCCTCT-A3TA3TA) at the phosphodiester bond following the sequence CCCTCT. We recovered a mutant form of the enzyme that cleaves DNA more efficiently than does the wild-type. Beginning with this selected mutant we have now scattered random mutations throughout the ribozyme and have begun an evolutionary search to further expand the catalytic repertoire of RNA. Author

N92-13611*# Scripps Institution of Oceanography, La Jolla, CA.

SOURCES AND GEOCHEMICAL EVOLUTION OF CYANIDE AND FORMALDEHYDE Abstract Only

G. Arrhenius *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 44 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

The major source of cyanide has, in current paleoatmospheric models, been assumed to be the reaction of photodissociated thermospheric nitrogen with a limiting supply of stratospheric methane. Formaldehyde may be produced with more ease from an atmosphere of carbon dioxide as the dominant carbon species, and from carbonate in solution or sorbed in double layer hydroxide

minerals. Potentially more important sources for cyanide and other carbon containing molecules are the partially photoprotected northern and southern auroral ovals where continuous currents reaching several mega-amperes induce ion-molecule reactions, extending into the lower stratosphere. In simulated environments of this kind, the cyanide ion is known to be produced from oxidized carbon species potentially more abundant than methane. Rainout of cyanide and formaldehyde place them in two different geochemical reaction reservoirs. In the anoxic Archean hydrosphere, about 1mM in Fe2(+), the cyanide ion would have been efficiently converted to the stable ferrocyanide complex Fe(CN) sub 6(4-), protecting it from the commonly considered fate of decomposition by hydrolysis, and eventually incorporating it in pyroaurite type minerals, most efficiently in green rust where it converts to insoluble ferriferrocyanide, prussian blue. Author

N92-13612*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
KAOLINITE-CATALYZED AIR OXIDATION OF HYDRAZINE: CONSIDERATION OF SEVERAL COMPOSITIONAL, STRUCTURAL AND ENERGETIC FACTORS IN SURFACE ACTIVATION Abstract Only
L. M. Coyne, R. Mariner, and A. Rice *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 45 Prepared in cooperation with San Jose State Univ., CA (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Clay minerals have been shown to have numerous, curious, energetic properties by virtue of ultra-violet light release which can be triggered by gentle environmental changes such as wetting and dewetting by a variety of liquids, unique among them water and hydrazine. Since both water and hydrazine play multiple key roles in the air-oxidation of hydrazine on kaolinite surfaces, this reaction would seem to have prime potential for studying interrelationships of energy storage, release and chemical reactivity of clay surfaces, capacities basic to either the Bernal or Cairns-Smith roles of minerals in the origin of life. Establishment of the capacity for stored electronic energy to significantly alter surface chemistry is important, regardless of the reaction chosen to demonstrate it. Hydrazine air oxidation is overawingly complex, given the possibilities for step-wise control and monitoring of parameters. In the light of recently extended characterization of the kaolinite and model sheet catalysts we used to study hydrazine oxidation and gamma-irradiated silica, previous studies of hydrazine air-oxidation on aluminosilicate surfaces have been reevaluated. Our former conclusion remains intact that, whereas trace structural and surface contaminants do play some role in the catalysis of oxidation, they are not the only, nor even the dominant, catalytic centers. Initial intermediates in the oxidation can now be proposed which are consistent with production via O(-)-centers as well as ferric iron centers. The greater than square dependence of the initial reaction rate on the weight of the clay is discussed in the light of these various mechanistic possibilities. Author

N92-13613*# Cornell Univ., Ithaca, NY.
TERRESTRIAL PRODUCTION VS. EXTRATERRESTRIAL DELIVERY OF PREBIOTIC ORGANICS TO THE EARLY EARTH Abstract Only
C. F. Chyba, C. Sagan, P. J. Thomas, and L. Brookshaw (Lawrence Livermore National Lab., CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 46 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

A comprehensive treatment of comet/asteroid interaction with the atmosphere, ensuring surface impact, and resulting organic pyrolysis is required to determine whether more than a negligible fraction of the organics in incident comets and asteroids actually survived collision with Earth. Results of such an investigation, using a smoothed particle hydrodynamic simulation of cometary and asteroidal impacts into both oceans and rock, demonstrate that organics will not survive impacts at velocities approx. greater than 10 km s(exp -1), and that even comets and asteroids as small as 100m in radius cannot be aerobraked to below this velocity in 1 bar atmospheres. However, for plausible dense (10 bar CO2) early atmospheres, there will be sufficient aerobraking during atmospheric passage for some organics to survive the ensuing impact. Combining these results with analytical fits to the lunar impact record shows that 4.5 Gyr ago Earth was accreting at least approx. 10(exp 6) kg yr(exp -1) of intact cometary organics, a flux which thereafter declined with a approx. 100 Myr half-life. The extent to which this influx was augmented by asteroid impacts, as well as the effect of more careful modelling of a variety of conservative approximations, is currently being quantified. These results may be placed in context by comparison with in situ organic production from a variety of terrestrial energy sources, as well as organic delivery by interplanetary dust. Which source dominated the early terrestrial prebiotic inventory is found to depend on the nature of the early terrestrial atmosphere. However, there is an intriguing symmetry: it is exactly those dense CO2 atmospheres where in situ atmospheric production of organic molecules should be the most difficult, in which intact cometary organics would be delivered in large amounts. Author

N92-13614*# California Univ., Davis.
SELF ASSEMBLY PROPERTIES OF PRIMITIVE ORGANIC COMPOUNDS Abstract Only
D. W. Deamer *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 47 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

A central event in the origin of life was the self-assembly of amphiphilic, lipid-like compounds into closed microenvironments. If a primitive macromolecular replicating system could be encapsulated within a vesicular membrane, the components of the system would share the same microenvironment, and the result would be a step toward true cellular function. The goal of our research has been to determine what amphiphilic molecules might plausibly have been available on the early Earth to participate in the formation of such boundary structures. To this end, we have investigated primitive organic mixtures present in carbonaceous meteorites such as the Murchison meteorite, which contains 1-2 percent of its mass in the form of organic carbon compounds. It is likely that such compounds contributed to the inventory of organic carbon on the prebiotic earth, and were available to participate in chemical evolution leading to the emergence of the first cellular life forms. We found that Murchison components extracted into non-polar solvent systems are surface active, a clear indication of amphiphilic character. One acidic fraction self-assembles into vesicular membranes that provide permeability barriers to polar solutes. Other evidence indicates that the membranes are bimolecular layers similar to those formed by contemporary membrane lipids. We conclude that bilayer membrane formation by primitive amphiphiles on the early Earth is feasible. However, only a minor fraction of acidic amphiphiles assembles into bilayers, and the resulting membranes require narrowly defined conditions of pH and ionic composition to be stable. It seems unlikely, therefore, that meteoritic infall was a direct source of membrane amphiphiles. Instead, the hydrocarbon components and their derivatives more probably would provide an organic stock available for chemical evolution. Our current research is directed at possible reactions which would generate substantial quantities of membranogenic amphiphiles. One possibility is photochemical oxidation of hydrocarbons. Author

N92-13615*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STRUCTURE AND FUNCTIONS OF WATER-MEMBRANE INTERFACES AND THEIR ROLE IN PROTO-BIOLOGICAL EVOLUTION Abstract Only
A. Pohorille, M. Wilson, and R. D. MacElroy *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 48 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Among the most important developments in proto-biological evolution was the emergence of membrane-like structures. These are formed by spontaneous association of relatively simple amphiphilic molecules that would have been readily available in the primordial environment. The resulting interfacial regions between water and nonpolar interior of the membrane have several properties which made them uniquely suitable for promoting subsequent evolution. They can (1) selectively attract organic material and mediate its transport, (2) serve as simple catalysts for chemical reactions, and (3) promote the formation of trans-membrane electrical and chemical gradients which could provide energy sources for proto-cells. Understanding the structure of interfaces, their interactions with organic molecules and molecular mechanisms of their functions is an essential step to understanding proto-biological evolution. In our computer simulation studies, we showed that the structure of water at interfaces with nonpolar media is significantly different from that in the bulk. In particular, the average surface dipole density points from the vapor to the liquid. As a result, negative ions can approach the interface more easily than positive ions. Amphiphilic molecules composed of hydrocarbon conjugated rings and polar substituents (e.g., phenol) assume at the interface rigid orientations in which polar groups are buried in water while hydrocarbon parts are located in the nonpolar environment. These orientational differences are of special interest in connection with the ability of some of these molecules to efficiently absorb photons. Flexible molecules with polar substituents often adopt at interfaces conformations different from those in the bulk aquaeous solution and in the gas phase. As a result, in many instances both specificity and kinetics of chemical reactions in which these molecules can participate is modified by the presence of surfaces. Of special interest is the mechanism by which polar molecules are transferred across interface between water and a nonpolar medium. Our recent study showed that simple ionophores bind ions by the same mechanisms as ion channels and carriers from modern cells. Author

N92-13616*# Roswell Park Memorial Inst., Buffalo, NY. Dept. of Biophysics.

MACROMOLECULAR RECOGNITION: STRUCTURAL ASPECTS OF THE ORIGIN OF THE GENETIC SYSTEM Abstract Only

Robert Rein, Dov Barak, Ning Luo, Theresa Julia Zielinski, and Masayuki Shibata *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 49 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

Theoretical simulation of prebiotic chemical processes is an invaluable tool for probing the phenomenon of evolution of life. Using computational and modeling techniques and guided by analogies from present day systems we, seek to understand the emergence of genetic apparatus, enzymatic catalysis and protein synthesis under prebiotic conditions. In one possible scenario, the RNA enzymatic reaction plays a key role in the emergence of the self-replicating and offers a clue to the onset of enzymatic catalysis prior to the existence of the protein biosynthetic machinery. Our ultimate goal is to propose a simple RNA segment which contains the specificity and catalytic activity of the contemporary RNA enzyme and which could emerge in a primordial chemical environment. To understand the mechanism of ribozyme catalyzed reactions, ab initio and semi-empirical (ZINDO) programs were used to investigate the reaction path of transphosphorylation. A special emphasis was placed on the possible catalytic and structural roles played by the coordinated magnesium cation. Both the inline and adjacent mechanisms of transphosphorylation have been studied. Another important aspect of this reaction is the identity of the functional groups which are essential for the acid base catalysis. The structural characteristics of the target helices, particularly a possible role of G center dot T pair, is under examination by molecular dynamics (MD) simulation technique. Modeling of the ancestral aminoacyl-tRNA synthetases (aRS) may provide important clues to the emergence of the genetic code and the protein synthetic machinery. Assuming that the catalytic function evolved before the elements of specific recognition of a particular amino acid, we are exploring the minimal structural requirements for the catalysis of tRNA aminoacylation. The molecular modeling system SYBYL was used for this study based on the high resolution crystallographic structures of the present day tyrosyl-adenylate:tyrRS and tRNA(Gln): ATP:glnRS complexes. The trinucleotide CCA of the 3'-end tRNA is placed into the active site pocket of tyrRS, based on the scheme of interaction between tRNA(Gln) and glnRS, and upon the stereochemistry of the tyrRS:tRNA:Tyr-AMP transition state. This provides a model of the non-specific recognition of a tRNA's 3'-end by an aRS, which might be similar to that of the ancestral aRS's. In the next step, modeling of the rest of the acceptor stem of tRNA (Tyr) with tyrRS is carried out. Author

N92-13617*# Salk Inst. for Biological Studies, San Diego, CA.

TEMPLATE POLYMERIZATION OF NUCLEOTIDE ANALOGUES Abstract Only

L. E. Orgel *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 50 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

Recent work on the template-directed reactions of the natural D-nucleotides has made it clear that l-nucleotides and nucleotide-like derivatives of other sugars would strongly inhibit the formation of long oligonucleotides. Consequently, attention is focusing on molecules simpler than nucleotides that might have acted as monomers of an information transfer system. We have begun a general exploration of the template directed reactions of diverse peptide analogues. I will present work by Dr. Taifeng Wu on oxidative oligomerization of phosphorothioates and of Dr. Mary Tohidi on the cyclic polymerization of nucleoside and related cyclic pyrophosphates. Author

N92-13618*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PRODUCT AND RATE DETERMINATIONS WITH CHEMICALLY ACTIVATED NUCLEOTIDES IN THE PRESENCE OF VARIOUS PREBIOTIC MATERIALS, INCLUDING OTHER MONO- AND POLYNUCLEOTIDES Abstract Only

A. Kanavarioti, D. J. Alberas, M. T. Rosenbach, C. F. Bernasconi (California Univ., Santa Cruz.), and S. Chang *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 51 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

We are investigating the reactions of ImpN's in the presence of a number of prebiotically plausible materials, such as metal ions, phosphate, amines and other nucleotides and hope to learn more about the stability/reactivity of ImpN's in a prebiotic aqueous environment. We find that, in the presence of phosphate, ImpN's form substantial amounts of diphosphate nucleotides. These diphosphate nucleotides are not very good substrates for template directed reactions, but are chemically activated and are known to revert to the phosphoimidazolides in the presence of imidazole under solid state conditions. With respect to our studies of the oligomerization reaction, the determination of the dimerization rate constant of a specific ImpN (guanosine 5'-phospho 2 methylimidazolide) both in the absence and the presence of the template leads to the conclusion that at 37 C the dimerization is not template directed, although the subsequent polymerization steps are. In other words, this specific polynucleotide synthesizing system favors the elongation of oligonucleotides as compared with the formation of dimers and trimers. This favoring of the synthesis of long as opposed to short oligonucleotides may be regarded as a rudimentary example of natural selection at the molecular level. Author

N92-13619*# Salk Inst. for Biological Studies, San Diego, CA.

CARBOHYDRATES AS A SOURCE OF ENERGY AND MATTER FOR THE ORIGIN OF LIFE Abstract Only

A. L. Weber *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 52 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

Recently, we proposed a new model of early glycolysis in which the oxidation of glyceraldehyde self-hemiacetals yielded energy rich polyglyceric acid instead of energy rich thioesters. In this model, polyglyceric acid not only acts as an energy source for phosphoanhydride synthesis, but also as an autocatalyst that can replicate the sequence of D and L residues in its structure. We began our investigation of this new hypothesis - the triose model - by developing a thermal method for the racemization-free synthesis of polyglyceric acid. The hydrolytic stability and the role of chirality in interactions of polyglyceric acid were studied using this thermal polymer. Next, we established that the 2- and 3-glycerol esters of polyglyceric acid are energy rich by measuring the Gibbs free energy change of hydrolysis of the 2- and 3-glycerol esters of 2 and 3-O-L glyceroyl-glyceric acid methyl ester - a model of polyglyceric acid. Recently, we discovered that glyceraldehyde is bound and oxidized to glyceric acid on the surface of ferric hydroxide and that soluble ferric ion catalyzes the rearrangement of glyceraldehyde to lactic acid. We are exploring the possibility that these reactions could yield polyglyceric acid and polylactic acid under plausible prebiotic conditions. Author

N92-13620*# Houston Univ., TX. Dept. of Biochemical and Biophysical Sciences.
ON THE ORIGIN AND EARLY EVOLUTION OF BIOLOGICAL CATALYSIS AND OTHER STUDIES ON CHEMICAL EVOLUTION Abstract Only
J. Oro and A. Lazcano (Universidad Nacional Autonoma de Mexico, Mexico City.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 53 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

One of the lines of research in molecular evolution which we have developed for the past three years is related to the experimental and theoretical study of the origin and early evolution of biological catalysis. In an attempt to understand the nature of the first peptidic catalysts and coenzymes, we have achieved the non-enzymatic synthesis of the coenzymes ADPG, GDPG, and CDP-ethanolamine, under conditions considered to have been prevalent on the primitive Earth. We have also accomplished the prebiotic synthesis of histidine, as well as histidyl-histidine, and we have measured the enhancing effects of this catalytic dipeptide on the dephosphorylation of deoxyribonucleotide monophosphates, the hydrolysis of oligo A, and the oligomerization 2', 3' cAMP. We reviewed and further developed the hypothesis that RNA preceded double stranded DNA molecules as a reservoir of cellular genetic information. This led us to undertake the study of extant RNA polymerases in an attempt to discover vestigial sequences preserved from early Archean times. In addition, we continued our studies of on the chemical evolution of organic compounds in the solar system and beyond. Author

N92-13621*# Alabama Univ., Birmingham. Dept. of Biochemistry.
CHEMISTRY OF AMINOACYLATION OF 5'-AMO AND THE ORIGIN OF PROTEIN SYNTHESIS Abstract Only
J. C. Lacey, Jr. *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 54 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Much of our recent work has been a study of aminoacyl AMP derivatives. Elucidation of the character of aminoacyl AMP derivatives has made it obvious that AMP has characteristics which should allow it to preferentially catalyze the synthesis of L-amino acid peptides. The essential features which lead to this conclusion are that all l-amino acids (but not all D amino acids) when esterified to 5'-AMP preferentially (65 percent) distribute to the 3' position of the 5'-AMP; that esterification is predominantly at the 2' position; that 2', 3' diaminoacyl esters are readily formed; and that a peptide bond can be formed between adjacent 2',3' aminoacyl esters. Author

N92-13622*# Cornell Univ., Ithaca, NY. Dept. of Chemistry.
CATALYTIC RNA AND SYNTHESIS OF THE PEPTIDE BOND Abstract Only
D. A. Usher, M. Kozlowski, and X. Zou *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 55 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

We are studying whether the L-19 IVS ribozyme from Tetrahymena thermophila can catalyze the formation of the peptide bond when it is supplied with synthetic aminoacyl oligonucleotides. If this reaction works, it could give us some insight into the mechanism of peptide bond formation and the origin of coded protein synthesis. Two short oligoribonucleotides, CCCCC and a protected form of CCCCU were prepared; the former was made by the controlled hydrolysis of Poly(C), and the later by multistep chemical synthesis from the protected monomers. The homopentamer was then aminocylated using C-14 labelled Boc-protected glycine imidazolide. This aminoacylated oligo-nucleotide has now been shown to enter the active site of the L-19 IVS, and aminoacyl transfer, and peptide bond formation reactions are being sought. Our synthesis of CCCCU made us aware of the inadequacy of many of the 2'- hydroxyl protecting groups that are in use today and we therefore designed a new 2'- protecting group that is presently being tested. Author

N92-13623*# Harvard Univ., Cambridge, MA.
NEW EVIDENCE FOR A DRAMATIC RISE IN ATMOSPHERE OXYGEN CA. 1,900 M.Y. AGO Abstract Only **c45**
H. D. Holland and A. W. Macfarlane *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 56 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 13B

Several lines of geologic evidence have pointed to a significant increase in P sub O2 about 2,000 m.y. ago, but the magnitude of P sub O2 before and after that time has been quite uncertain. The data that we have recently accumulated suggest that P sub O2 was approximately less than 2 x 10 (exp -3) atm more than 2,000 m.y. ago, and approximately greater than 0.03 atm more recently than ca. 1,900 m.y. ago. These estimates are based on the behavior of iron in Precambrian weathering horizons. More than ca. 2,000 m.y. ago, Fe(+2), released during the weathering of basalts was not oxidized to Fe(+3), and was removed in ground water from the upper layers of soil horizons. More recently than ca. 1,850 m.y. ago, Fe(+2) was oxidized to Fe(+3) and precipitated as iron oxides and hydroxides in such soil horizons and in the weathering products of a carbonate facies banded iron formation in Griqualand West, South Africa. The O2 content of the atmosphere must have increased dramatically about 1,900 m.y. ago to explain these observations. The reasons for the increase are still obscure, but are probably related to changes in the biologic productivity of the oceans. Eukaryotes appear to have developed shortly after the increase in P sub O2, perhaps in response to the subsequent increase in the supply of nitrate from the atmosphere to the oceans. Author

N92-13624*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BIOSPHERIC-ATMOSPHERIC COUPLING ON THE EARLY EARTH **c45**
J. S. Levine *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 57 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 13B

Theoretical calculations performed with a one-dimensional photochemical model have been performed to assess the biospheric-atmospheric transfer of gases. Ozone reached levels to shield the Earth from biologically lethal solar ultraviolet radiation (220-300 nm) when atmospheric oxygen reached about 1/10 of its present atmospheric level. In the present atmosphere, about 90 percent of atmospheric nitrous oxide is destroyed via solar photolysis in the stratosphere with about 10 percent destroyed

via reaction with excited oxygen atoms. The reaction between nitrous oxide and excited oxygen atoms leads to the production of nitric oxide in the stratosphere, which is responsible for about 70 percent of the global destruction of oxygen in the stratosphere. In the oxygen/ozone deficient atmosphere, solar photolysis destroyed about 100 percent of the atmospheric nitrous oxide, relegating the production of nitric oxide via reaction with excited oxygen to zero. Our laboratory and field measurements indicate that atmospheric oxygen promotes the biogenic production of N2O and NO via denitrification and the biogenic production of methane by methanogenesis. Author

N92-13625*# George Mason Univ., Fairfax, VA.
A WINDOW IN TIME FOR THE FIRST EVOLUTIONARY RADIATION Abstract Only
H. J. Morowitz *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 58 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The window in time between the last globally sterilizing event and the evidence for a complex procaryotic ecosystem is quite narrow, perhaps as small as 200 million years. We will present a heuristic model outlining the first evolutionary radiation that could have led from primordial vesicles to the universal ancestor. The concept of the universal ancestor will be developed in terms of contemporary molecular biology. Author

N92-13626*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE EFFECTS OF OXYGEN ON THE EVOLUTION OF MICROBIAL MEMBRANES Abstract Only
L. L. Jahnke *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 62 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

One prokaryote, Methylococcus capsulatus, synthesizes both hopanoids and sterols and, thus, provides a unique opportunity to study the evolution of membrane function. When M. capsulatus was grown at different temperatures, lipid analysis of the whole cells showed that both sterol and unsaturated fatty acid levels decreased at higher growth temperatures; sterol concentrations were 0.116 micro mole/micro mole phospholipid at 30 C and 0.025 micro mole/mirco mole phospholipid at 45 C, while the saturated to unsaturated fatty acid ratio increased from 0.397 to 1.475. Hopane polyol levels were constant over this range; however, methylation of the A-ring decreased markedly in cells grown at 30 C. These results imply that sterol and hopane molecules are required for enhancement of some specific membrane function, potentially by modulating membrane fluidity. Author

N92-13627*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ON THE CHIMERICAL NATURE OF THE MEMBRANE-BOUND ATPASE FROM HALOBACTERIUM SACCHAROVORUM Abstract Only
L. I. Hochstein *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 63 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

A series of experiments are described that were carried out with the goal of determining how the membrane-bound ATPase from H. saccharovorum is related to V- and F-type ATPases. They reflect three approaches: the use of inhibitors; structural studies; and immunological relatedness. Author

N92-13628*# California Univ., Irvine.
ARCHAEBACTERIAL RHODOPSIN SEQUENCES: IMPLICATIONS FOR EVOLUTION
J. K. Lanyi *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 64 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

It was proposed over 10 years ago that the archaebacteria represent a separate kingdom which diverged very early from the eubacteria and eukaryotes. It follows that investigations of archaebacterial characteristics might reveal features of early evolution. So far, two genes, one for bacteriorhodopsin and another for halorhodopsin, both from Halobacterium halobium, have been sequenced. We cloned and sequenced the gene coding for the polypeptide of another one of these rhodopsins, a halorhodopsin in Natronobacterium pharaonis. Peptide sequencing of cyanogen bromide fragments, and immuno-reactions of the protein and synthetic peptides derived from the C-terminal gene sequence, confirmed that the open reading frame was the structural gene for the pharaonis halorhodopsin polypeptide. The flanking DNA sequences of this gene, as well as those of other bacterial rhodopsins, were compared to previously proposed archaebacterial consensus sequences. In pairwise comparisons of the open reading frame with DNA sequences for bacterio-opsin and halo-opsin from Halobacterium halobium, silent divergences were calculated. These indicate very considerable evolutionary distance between each pair of genes, even in the dame organism. In spite of this, three protein sequences show extensive similarities, indicating strong selective pressures. Author

N92-13629*# California Univ., Berkeley.
THIOREDOXIN AND EVOLUTION
B. B. Buchanan *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 65 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Comparisons of primary structure have revealed significant homology between the m type thioredoxins of chloroplasts and the thioredoxins from a variety of bacteria. Chloroplast thioredoxin f, by comparison, remains an enigma: certain residues are invariant with those of the other thioredoxins, but a phylogenetic relationship to bacterial or m thioredoxins seems distant. Knowledge of the evolutionary history of thioredoxin f is, nevertheless, of interest because of its role in photosynthesis. Therefore, we have attempted to gain information on the evolutionary history of chloroplast thioredoxin f, as well as m. Our goal was first to establish the utility of thioredoxin as a phylogenetic marker, and, if found suitable, to deduce the evolutionary histories of the chloroplast thioredoxins. To this end, we have constructed phylogenetic (minimal replacement) trees using computer analysis. The results show that the thioredoxins of bacteria and animals fall into distinct phylogenetic groups - the bacterial group resembling that derived from earlier 16s RNA analysis and the animal group showing a cluster consistent with known relationships. The chloroplast thioredoxins show a novel type of phylogenetic arrangement: one m type aligns with its counterpart of eukaryotic algae, cyanobacteria and other bacteria, whereas the second type (f type) tracks with animal thioredoxin. The results give new insight into the evolution of photosynthesis. Author

N92-13630*# Houston Univ., TX.
EXPLORATION OF RNA STRUCTURE SPACES Abstract Only
G. E. Fox *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 66 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

In order to understand the structure of real structure spaces, we are studying the 5S rRNA structure space experimentally. A plasmid containing a synthetic 5S rRNA gene, two rRNA promoters, and transcription terminators has been assembled. Assays are conducted to determine if the foreign 5S rRNA is expressed, and to see whether or not it is incorporated into ribosomes. Evolutionary competition is used to determine the relative fitness of strains containing the foreign 5S rRNA and a control 5S rRNA. By using site directed mutagenesis, a number of mutants can be made in order to study the boundaries of the structure space and how sharply defined they are. By making similar studies in the vicinity of structure space, it will be possible to determine how homogeneous the 5S rRNA structure space is. Useable experimental protocols have been developed, and a number of

mutants have already been studied. Initial results suggest an explanation of why single stranded regions of the RNA are less subject to mutation than double stranded regions. Author

N92-13631*# Virginia Univ., Charlottesville. Dept. of Biology.
FUNCTIONAL CHARACTERISTICS OF THE CALCIUM MODULATED PROTEINS SEEN FROM AN EVOLUTIONARY PERSPECTIVE
R. H. Kretsinger, S. Nakayama, and N. D. Moncrief *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 67 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

We have constructed dendrograms relating 173 EF-hand proteins of known amino acid sequence. We aligned all of these proteins by their EF-hand domains, omitting interdomain regions. Initial dendrograms were computed by minimum mutation distance methods. Using these as starting points, we determined the best dendrogram by the method of maximum parsimony, scored by minimum mutation distance. We identified 14 distinct subfamilies as well as 6 unique proteins that are perhaps the sole representatives of other subfamilies. This information is given in tabular form. Within subfamilies one can easily align interdomain regions. The resulting dendrograms are very similar to those computed using domains only. Dendrograms constructed using pairs of domains show general congruence. However, there are enough exceptions to caution against an overly simple scheme in which one pair of gene duplications leads from one domain precurser to a four domain prototype from which all other forms evolved. The ability to bind calcium was lost and acquired several times during evolution. The distribution of introns does not conform to the dendrogram based on amino acid sequences. The rates of evolution appear to be much slower within subfamilies, especially within calmodulin, than those prior to the definition of subfamily.
Author

N92-13632*# Arizona State Univ., Tempe. Center for the Study of Early Events in Photosynthesis.
PHOTOSYNTHETIC REACTION CENTER COMPLEXES FROM HELIOBACTERIA Abstract Only
J. T. Trost, W. F. J. Vermaas, and R. E. Blankenship *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 68 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The goal of this project is to understand the early evolutionary development of photosynthesis by examining the properties of reaction centers isolated from certain contemporary organisms that appear to contain the simplest photosynthetic reaction centers. The major focus of this project is the family of newly discovered strictly anaerobic photosynthetic organisms known as Heliobacteria. These organisms are the only known photosynthetic organisms that are grouped with the gram-positive phylum of bacteria. The properties of these reaction centers suggest that they might be the decendants of an ancestor that also gave rise to Photosystem 1 found in oxygen-evolving photosynthetic organisms. Photoactive reaction center-core antenna complexes have been isolated from the photosynthetic bacteria Heliobacillus mobilis and Heliobacterium gestii. The absorption and fluorescence properties of membranes and reaction centers are almost identical, suggesting that a single pigment-protein complex serves as both antenna and reaction center. Experiments in progress include sequence determination of the 48,000 Mr reaction center protein, and evolutionary comparisons with other reaction center proteins.
Author

N92-13633*# University of Southern Illinois, Carbondale. Dept. of Engineering.
MOLECULAR BASES FOR UNITY AND DIVERSITY IN ORGANIC EVOLUTION Abstract Only
S. W. Fox, P. Ruecknagel, and G. Braunitzer *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 69 Prepared in cooperation with Max-Planck-Inst. fuer Biochemie, Martinsried bei Muenchen (Fed. Republic of Germany) (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The origin of biological information has been ascribed at various times to DNA, RNA, or protein. The origin of nucleic acids without the action of prior informed protein has not been supported by plausible experiments, although such possibilities have been examined. The behavior of thermal proteins and of the microspheres selfassembled therefrom explain the origin of the first cells, the first membrane, the first reproduction cycle, ancient metabolism including ATP-aided synthesis of peptides and polynucleotides, growth, bioelectricity, and polybiofunctionality in general.
Author

N92-13634*# Indiana Univ., Bloomington. Biogeochemical Lab.
SEDIMENTARY ORGANIC MOLECULES: ORIGINS AND INFORMATION CONTENT Abstract Only
J. M. Hayes and K. H. Freeman *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 70 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

To progress in the study of organic geochemistry, we must dissect the processes controlling the composition of sedimentary organic matter. Structurally, this has proven difficult. Individual biomarkers can often be recognized, but their contribution to total organic materials is small, and their presence does not imply that their biochemical cell mates have survived. We are finding, however, that a combination of structural and isotopic lines of evidence provides new information. A starting point is provided by the isotopic compositions of primary products (degradation products of chlorophylls, alkenones derived from coccoliths). We find strong evidence that the isotopic difference between primary carbonate and algal organic material can be interpreted in terms of the concentration of dissolved CO2. Moreover, the isotopic difference between primary and total organic carbon can be interpreted in terms of characteristic isotopic shifts imposed by secondary processes (responsive, for example, to O2 levels in the depositional environment. In favorable cases, isotopic compositions of a variety of secondary products can be interpreted in terms of flows of carbon, and, therefore, in terms of specific processes and environmental conditions within the depositional environment.
Author

N92-13635*# Stanford Univ., CA. Dept. of Geology.
EARLY ARCHEAN STROMATOLITES: PALEOENVIRONMENTAL SETTING AND CONTROLS ON FORMATION Abstract Only
D. R. Lowe *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 71 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The earliest record of terrestrial life is contained in thin, silicified sedimentary layers within enormously thick, predominantly volcanic sequences in South Africa and Western Australia. This record includes bacteria-like microfossils, laminated carbonaceous structures resembling flat bacterial mats and stromatolites, and a morphologically diverse assemblage of carbonaceous particles. These structures and particles and their host sediments provide the only direct source of information on the morphology, paleoecology, and biogeochemistry of early life; the nature of interactions between organisms and surface systems on the early earth; and possible settings within which life might have evolved. The three known occurrences of 3.5 to 3.2 billion-year-old stromalites were evaluated in terms of depositional setting and biogenicity.
Author

N92-13636*# California Univ., Los Angeles. Dept. of Earth and Space Sciences.
EARLY ARCHEAN (APPROXIMATELY 3.4 Ga) PROKARYOTIC FILAMENTS FROM CHERTS OF THE APEX BASALT, WESTERN AUSTRALIA: THE OLDEST CELLULARLY PRESERVED MICROFOSSILS NOW KNOWN Abstract Only
J. W. Schopf *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 72 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

In comparison with that known from later geologic time, the Archean fossil record is miniscule: although literally hundreds of Proterozoic formations, containing more that 2800 occurrences of bona fide microfossils are now known, fewer than 30 units containing some 43 categories of putative microfossils (the vast majority of which are of questionable authenticity) have been reported from the Archean. Among the oldest known fossils are Early Archean filaments reported from cherts of the Towers Formation and the Apex Basalt of the 3.3-3.6 Ga-old Warrawoona Group of Western Australia. The paleobiologic significance of the Towers Formation microstructures is open to question: thin aggregated filaments are properly regarded as dubiomicrofossils (perhaps biogenic, but perhaps not); therefore, they cannot be regarded as firm evidence of Archean life. Although authentic, filamentous microfossiles were reported from a second Towers Formation locality, because the precise layer containing the fossiliferous cherts was not relocated, this discovery can neither be reconfirmed by the original collector nor confirmed independently by other investigators. Discovery of microfossils in bedded cherts of the Apex Basalt, the stratigraphic unit immediately overlying the Towers Formation, obviates the difficulties stored above. The cellularly preserved filaments of the Apex Basalt meet all of the criteria required of a bona fide Archean microfossils. Recent studies indicate that the Apex assemblage includes at least six morphotypes of uniseriate filaments, composed of barrel-shaped, discoidal, or quadrate cells and exhibiting rounded or conical terminal cells and medial bifurcated and paired half-cells that reflect the occurrence of prokaryotic binary cell division. Interestingly, the majority of these morphotypes are morphologically more similar to extant cyanobacteria than to modern filamentous bacteria. Prokaryotes seem clearly to have been hypobradytelic, and the evidence suggests (but does not prove) that physiologically advanced oxygen-producing photosynthesizers may have been represented in the Early Archean biota. Author

N92-13637*# Harvard Univ., Cambridge, MA.
THE ENVIRONMENTAL DISTRIBUTION OF LATE PROTEROZOIC ORGANISMS Abstract Only
A. H. Knoll *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 73 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Along present day coast lines, the environmental distributions of prokaryotic and protistan populations are often sharply delimited. Realized habitat ranges are generally narrower than those circumscribed by physiological tolerances, suggesting the importance of organism-organism interactions in the determination of population distributions. Microfossil populations preserved in silicified carbonates, dolomites, and shales of the 700-800 Ma old Akademikerbreen Group, Svalbard, and elsewhere indicate that the environmental distributions were defined equally clearly during the Proterozoic Eon. The Draken Conglomerate Formation is a tidal flat/lagoonal complex in which we have distinguished five principle biofacies containing a total of 42 taxa. Supratidal to subtidal gradients include the increasing abundance and diversity of both mat dweller microbenthos and allochthonous (principally planktonic) organisms, as well as a taphonomically important pattern of decreasing sheath thickness among mat builder microorganisms. The seaward barriers of Akademikerbreen lagoons were oolitic shoals, and these contain about a dozen endolithic and epilithic species not observed elsewhere in the group. Subtidal environments below fair weather wave base are represented by mudstones of the Svanbergfjellet Formation. These contain abundant and diverse cyanobacteria-like fossils generally similar to but specifically different from those found in tidal flat sediments, as well as diverse unicellular protists (some of impressive morphological complexity) and at least half a dozen cellularly preserved metaphyte populations. In all, more than 80 species are distributed among Akademikerbreen lithologies. Fossil assemblages from Svalbard and elsewhere illustrate the potential for a much finer paleoecological, biostratigraphic, and, hence, evolutionary resolution of the early fossil record. Author

N92-13638*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE BIOGEOCHEMISTRY OF MICROBIAL MATS, STROMATOLITES AND THE ANCIENT BIOSPHERE
D. J. DesMarais and D. E. Canfield *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 74 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Stromatolites offer an unparalleled geologic record of early life, because they constitute the oldest and most abundant recognizable remains of microbial ecosystems. Microbial mats are living homologs of stromatolites; thus, the physiology of the microbiota as well as the processes which create those features of mats (e.g., biomarker organic compounds, elemental and stable isotopic compositions) which are preserved in the ancient record. Observations of the carbon isotopic composition (delta C-13) of stromatolites and microbial mats were made and are consistent with the hypothesis that atmospheric CO2 concentrations have declined by at least one to two orders of magnitude during the past 2.5 Ga. Whereas delta C-13 values of carbonate carbon average about 0 permil during both the early and mid-Proterozoic, the delta C-13 values of stromatolitic organic matter increase from an average of -35 between 2.0 and 2.6 Ga ago to an average of about -28 about 1.0 Ga ago. Modern microbial mats in hypersaline environments have delta C-13 values typically in the range of -5 to -9, relative to an inorganic bicarbonate source at 0 permil. Both microbial mats and pur cultures of cyanobacteria grown in waters in near equilibrium with current atmospheric CO2 levels exhibit minimal discrimination against C-13. In contrast, hot spring cyanobacterial mats or cyanobacterial cultures grown under higher CO2 levels exhibit substantially greater discrimination. If care is taken to compare modern mats with stromatolites from comparable environments, it might be possible to estimate ancient levels of atmospheric CO2. In modern microbial mats, a tight coupling exists between photosynthetic organic carbon production and subsequent carbon oxidation, mostly by sulfate reduction. The rate of one process fuels a high rate of the other, with much of the sulfate reduction occurring within the same depth interval as oxygenic photosynthesis. Other aspects of this study are presented.
Author

N92-13639*# Massachusetts Univ., Amherst. Dept. of Botany.
SYMBIOSIS AND THE ORIGIN OF EUKARYOTIC MOTILITY Abstract Only
L. Margulis and G. Hinkle *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 75 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Ongoing work to test the hypothesis of the origin of eukaryotic cell organelles by microbial symbioses is discussed. Because of the widespread acceptance of the serial endosymbiotic theory (SET) of the origin of plastids and mitochondria, the idea of the symbiotic origin of the centrioles and axonemes for spirochete bacteria motility symbiosis was tested. Intracellular microtubular systems are purported to derive from symbiotic associations between ancestral eukaryotic cells and motile bacteria. Four lines of approach to this problem are being pursued: (1) cloning the gene of a tubulin-like protein discovered in Spirocheata bajacaliforniesis; (2) seeking axoneme proteins in spirochets by antibody cross-reaction; (3) attempting to cultivate larger, free-living

spirochetes; and (4) studying in detail spirochetes (e.g., Cristispira) symbiotic with marine animals. Other aspects of the investigation are presented. Author

N92-13640*# Pennsylvania State Univ., University Park. Dept. of Geosciences.
IS CO2 CAPABLE TO KEEPING EARLY MARS WARM? Abstract Only
J. F. Kasting *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 76 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

One of the goals of NASA's Exobiology Research Program is to determine whether life exists today on Mars (unlikely) or whether it might have existed there at some time in the past (more likely). Speculation about extinct life is driven by the observation of channels on the Martian surface, thought to indicate the past presence of liquid water and, hence, the existence of a warmer climate. Current thinking suggests that such a climate could have been maintained if early Mars had a dense CO2 atmosphere with a surface pressure of 1 to 5 bars. One of the phenomena that Martian climate modelers have not looked at very carefully is the process of CO2 condensation. Reexamination of some of my own calculations indicates that condensation should occur at high altitudes in some high-CO2, Martian atmospheres, particularly those in which the solar constant is set to its initial main sequence value (about 70 percent of present. CO2 condensation should affect the surface temperature in two ways: (1) if it occurs in the convective lower atmosphere, condensation will reduce the magnitude of the greenhouse effect by decreasing the lapse rate; and (2) condensation at any altitude will produce clouds, which can either warm or cool the climate depending on their altitude and optical depth. Preliminary calculations with a 1-D, radiative-convective climate model indicate that the lapse rate change is substantial for low solar luminosity models. Other aspects of this study are discussed. Author

N92-13641*# California Univ., Santa Barbara. Dept. of Geological Sciences.
NONMARINE STROMATOLITES AND THE SEARCH FOR EARLY LIFE ON MARS Abstract Only
S. M. Awramik *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 77 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The available evidence permits one to conclude that streams flowed and lakes developed on Mars sometime in the remote past. The lessons learned from the Earth's earliest fossil record suggest that stromatolites might have formed on Mars, speculating that: (1) biopoesis occurred on Mars during its earliest history; (2) life evolved and diversified; (3) life inhabited aqueous environments; and (4) sunlight was an important environmental resource. The most likely place to find stromatolites and possibly microbial fossils on Mars would be in ancient lake and stream deposits. If thermal spring deposits can be identified, then they too are sites for biogeological investigations. Other aspects of this study are presented. Author

N92-13642*# Florida Agricultural and Mechanical Univ., Tallahassee.
ENDOLITHIC MICROBIAL MODEL FOR MARTIAN EXOBIOLOGY: THE ROAD TO EXTINCTION Abstract Only
R. Oscampo-Friedmann and E. I. Friedmann (Florida State Univ., Tallahassee.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 78 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Martian exobiology is based on the assumption that on early Mars, liquid water was present and that conditions were suitable for the evolution of life. The cause for life to disappear from the surface and the recognizable fingerprints of past microbial activity preserved on Mars are addressed. The Antarctic cryptoendolithic microbial ecosystem as a model for extinction in the deteriorating Martian environment is discussed. Author

N92-13643*# Massachusetts Univ., Amherst. Dept. of Botany.
THE NASA PLANETARY BIOLOGY INTERNSHIP EXPERIENCE Abstract Only
G. Hinkle and L. Margulis *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 79 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

By providing students from around the world with the opportunity to work with established scientists in the fields of biogeochemistry, remote sensing, and origins of life, among others, the NASA Planetary Biology Internship (PBI) Program has successfully launched many scientific careers. Each year approximately ten interns participate in research related to planetary biology at NASA Centers, NASA-sponsored research in university laboratories, and private institutions. The PBI program also sponsors three students every year in both the Microbiology and Marine Ecology summer courses at the Marine Biological Laboratory. Other information about the PBI Program is presented including application procedure. Author

N92-13644*# California Univ., Berkeley. Lawrence Berkeley Lab.
FINE STRUCTURE OF THE LATE EOCENE Ir ANOMALY IN MARINE SEDIMENTS Abstract Only
F. Asaro *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 84 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The Late Eocene Ir abundance profile in deep sea cores from Ocean Drilling Program Leg 113 Hole 689B on the Maude Rise off of Antarctica was studied with 410 samples continuously in 10 cm increments and measured with the Iridium Coincidence (ICS). The ICS was subsequently modified to measure 13 other elements simultaneously with the Ir. The abundance profiles of these elements were then determined in the Late Eocene Massignano section in central Italy with 250 samples (encompassing roughly 2 million years of accumulation) which were collected about every 5 cm in about 2 cm increments. These studies augmented a previous one (which included many elements) of deep sea cores from Deep Sea Drilling Project Site 592 on the Lord Howe Rise in the Tasman Sea between Australia and New Zealand. In the latter study, 50 samples (encompassing roughly 0.7 million years of accumulation) were collected continuously in 10 cm increments. The results from these studies are discussed. Author

N92-13645*# Chicago Univ., IL.
CUMULATIVE FREQUENCY DISTRIBUTION OF PAST SPECIES EXTINCTIONS Abstract Only
D. M. Raup *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 85 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Analysis of Sepkoski's compendium of the time ranges of 30,000+ taxa yields a mean duration of 28.4 ma for genera of fossil invertebrates. This converts to an average extinction rate of 3.5 percent per million years or about one percent every 286,000 years. Using survivorship techniques, these estimates can be converted to the species level, yielding a Phanerozoic average of one percent species extinction every 40,000 years. Variation in extinction rates through time is far greater than the null expectation of a homogeneous birth-death model and this reflects the well-known episodicity of extinction ranging from a few large mass extinctions to so-called background extinction. The observed variation in rates can be used to construct a cumulative frequency distribution of extinction intensity, and this distribution, in the form of a kill curve for species, shows the expected waiting times between extinction events of a given intensity. The kill curve is an average description of the extinction events of a given intensity. The kill curve is an average description of the extinction record

and does not imply any cause or causes of extinction. The kill curve shows, among other things, that only about five percent of total species extinctions in the Phanerozoic were involved in the five largest mass extinctions. The other 95 percent were distributed among large and small events not normally called mass extinctions. As an exploration of the possibly absurd proposition that most past extinctions were produced by the effects of large-body impact, the kill curve for species was mapped on the comparable distribution for comet and asteroid impacts. The result is a curve predicting the species kill for a given size of impacting object (expressed as crater size). The results are reasonable in that impacts producing craters less than 30 km (diameter) cause negligible extinction but those producing craters 100-150 km (diameter) cause extinction of species in the range of 45-60 percent. Author

N92-13646*# Chicago Univ., IL.
GEOGRAPHY OF CRETACEOUS EXTINCTIONS: DATA BASE DEVELOPMENT Abstract Only
D. M. Raup *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 86 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Data bases built from the source literature are plagued by problems of data quality. Unless the data acquisition is done by experts, working slowly, the data base may contain so much garbage that true signals and patterns cannot be detected. On the other hand, high quality data bases develop so slowly that satisfactory statistical analysis may never be possible due to the small sample sizes. Results of a test are presented of the opposite strategy: rapid data acquisition by non-experts with minimal control on data quality. A published list of 186 species and genera of fossil invertibrates of the latest Cretaceous Age (Maestrichtian) were located through a random search of the paleobiological and geological literature. The geographic location for each faunal list was then transformed electronically to Maestrichtian latitude and longitude and the lists were further digested to identify the genera occurring in each ten-degree, latitude-longitude block. The geographical lists were clustered using the Otsuka similarity coefficient and a standard unweight-pair-group method. The resulting clusters are remarkably consistent geographically, indicating that a strong biogeographic signal is visible despite low-quality data. A further test evaluated the geographic pattern of end-Cretaceous extinctions. All genera in the data base were compared with Sepkoski's compendium of time ranges of genera to determine which of the reported genera survived the Cretaceous mass extinction. In turn, extinction rates for the ten-degree, latitude-longitude blocks were mapped. The resulting distribution is readily interpretable as a robust pattern of the geography of the mass extinction. The study demonstrates that a low-quality data base, built rapidly, can provide a basis for meaningful analysis of past biotic events. Author

N92-13647*# Chicago Univ., IL.
THE FOSSIL RECORD OF EVOLUTION: DATA ON DIVERSIFICATION AND EXTINCTION Abstract Only
J. J. Sepkoski, Jr. *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 87 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Understanding of the evolution of complex life, and of the roles that changing terrestrial and extraterrestrial environments played in life's history, is dependent upon synthetic knowledge of the fossil record. Paleontologists have been describing fossils for more that two centuries. However, much of this information is dispersed in monographs and journal articles published throughout the world. Over the past several years, this literature was surveyed, and a data base on times of origination and extinction of fossil genera was compiled. The data base, which now holds approximately 32,000 genera, covers all taxonomic groups of marine animals, incorporates the most recent taxonomic assignments, and uses a detailed global time framework that can resolve originations and extinctions to intervals averaging three million years in duration. These data can be used to compile patterns of global biodiversity, measure rates of taxic evolution, and test hypotheses concerning adaptive radiations, mass extinctions, etc. Thus far, considerable effort was devoted to using the data to test the hypothesis of periodicity of mass extinction. Rates of extinction measured from the data base have also been used to calibrate models of evolutionary radiations in marine environments. It was observed that new groups, or clades of animals (i.e., orders and classes) tend to reach appreciable diversity first in nearshore environments and then to radiate in more offshore environments; during decline, these clades may disappear from the nearshore while persisting in offshore, deep water habitats. These observations have led to suggestions that there is something special about stressful or perturbed environments that promotes the evolution of novel kinds of animals that can rapidly replace their predecessors. The numerical model that is being investigated to study this phenomenon treats environments along onshore-offshore gradients as if they were discrete habitats. Other aspects of this investigation are presented. Author

N92-13648*# New York Univ., New York. Earth Systems Group.
BIOGEOCHEMICAL MODELING AT MASS EXTINCTION BOUNDARIES Abstract Only
M. R. Rampino and K. G. Caldeira *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 88 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The causes of major mass extinctions is a subject of considerable interest to those concerned with the history and evolution of life on earth. The primary objectives of the proposed plan of research are: (1) to develop quantitative time-dependent biogeochemical cycle models, coupled with an ocean atmosphere in order to improve the understanding of global scale physical, chemical, and biological processes that control the distribution of elements important for life at times of mass extinctions; and (2) to develop a comprehensive data base of the best available geochemical, isotopic, and other relevant geologic data from sections across mass extinction boundaries. These data will be used to constrain and test the biogeochemical model. These modeling experiments should prove useful in: (1) determining the possible cause(s) of the environmental changes seen at bio-event boundaries; (2) identifying and quantifying little-known feedbacks among the oceans, atmosphere, and biosphere; and (3) providing additional insights into the possible responses of the earth system to perturbations of various timescales. One of the best known mass extinction events marks the Cretaceous/Tertiary (K/T) boundary (66 Myr ago). Data from the K/T boundary are used here to constrain a newly developed time-dependent biogeochemical cycle model that is designed to study transient behavior of the earth system. Model results predict significant fluctuations in ocean alkalinity, atmospheric CO2, and global temperatures caused by extinction of calcareous plankton and reduction in the sedimentation rates of pelagic carbonates and organic carbon. Oxygen-isotome and other paleoclimatic data from K/T time provide some evidence that such climatic fluctuations may have occurred, but stabilizing feedbacks may have acted to reduce the ocean alkalinity and carbon dioxide fluctuations.
Author

N92-13649*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE NASA SETI PROGRAM
J. Billingham and D. H. Brocker *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 91 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

In 1959, it was proposed that a sensible way to conduct interstellar communication would be to use radio at or near the frequency of hydrogen. In 1960, the first Search for Extraterrestrial Intelligence (SETI) was conducted using a radiotelescope at Green

Bank in West Virginia. Since 1970, NASA has systematically developed a definitive program to conduct a sophisticated search for evidence of extraterrestrial intelligent life. The basic hypothesis is that life may be widespread in the univers, and that in many instances extraterrestrial life may have evolved into technological civilizations. The underlying scientific arguments are based on the continuously improving knowledge of astronomy and astrophysics, especially star system formation, and of planetary science, chemical evolution, and biological evolution. If only one in a million sun-like stars in our galaxy harbors species with cognitive intelligence, then there are 100,000 civilizations in the Milky Way alone. The fields of radioastronomy digital electronic engineering, spectrum analysis, and signal detection have advanced rapidly in the last twenty years and now allow for sophisticated systems to be built in order to attempt the detection of extraterrestrial intelligence signals. In concert with the scientific and engineering communities, NASA has developed, over the last several years, a Microwave Observing Project whose goal is to design, build, and operate SETI systems during the decade of the nineties in pursuit of the goal signal detection. The Microwave Observing Project is now approved and underway. There are two major components in the project: the Target Search Element and the Sky Survey Element. Author

N92-13650*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NASA-SETI MICROWAVE OBSERVING PROJECT: TARGETED SEARCH ELEMENT (TSE) Abstract Only
L. D. Webster *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 92 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The Targeted Search Element (TSE) performs one of two complimentary search strategies of the NASA-SETI Microwave Observing Project (MOP): the targeted search. The principle objective of the targeted search strategy is to scan the microwave window between the frequencies of one and three gigahertz for narrowband microwave emissions eminating from the direction of 773 specifically targeted stars. The scanning process is accomplished at a minimum resolution of one or two Hertz at very high sensitivity. Detectable signals will be of a continuous wave or pulsed form and may also drift in frequency. The TSE will possess extensive radio frequency interference (RFI) mitigation and verification capability as the majority of signals detected by the TSE will be of local origin. Any signal passing through RFI classification and classifiable as an extraterrestrial intelligence (ETI) candidate will be further validated at non-MOP observatories using established protocol. The targeted search will be conducted using the capability provided by the TSE. The TSE provides six Targeted Search Systems (TSS) which independently or cooperatively perform automated collection, analysis, storage, and archive of signal data. Data is collected in 10 megahertz chunks and signal processing is performed at a rate of 160 megabits per second. Signal data is obtained utilizing the largest radio telescopes available for the Targeted Search such as those at Arecibo and Nancay or at the dedicated NASA-SETI facility. This latter facility will allow continuous collection of data. The TSE also provides for TSS utilization planning, logistics, remote operation, and for off-line data analysis and permanent archive of both the Targeted Search and Sky Survey data. Author

N92-13651*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NASA SETI MICROWAVE OBSERVING PROJECT: SKY SURVEY ELEMENT Abstract Only
M. J. Klein *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 93 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The SETI Sky Survey Observing Program is one of two complimentary strategies that NASA plans to use in its microwave Search for Extraterrestrial Intelligence (SETI). The primary objective of the sky survey is to search the entire sky over the frequency range of 1.0 to 10.0 GHz for evidence of narrow band signals of extraterrestrial intelligent origin. Frequency resolutions of 30 Hz or narrower will be used across the entire band. Spectrum analyzers with upwards of ten million channels are required to keep the survey time approximately 6 years. Data rates in excess of 10 megabits per second will be generated in the data taking process. Sophisticated data processing techniques will be required to determine the ever changing receiver baselines, and to detect and archive potential SETI signals. Existing radio telescopes, including several of NASA's Deep Space Network (DSN) 34 meter antennas located at Goldstone, CA and Tidbinbilla, Australia will be used for the observations. The JPL has the primary responsibility to develop and carry out the sky survey. In order to lay the foundation for the full scale SETI Sky Survey, a prototype system is being developed at the JPL. The system will be installed at the new 34-m high efficiency antenna at the Deep Space Station (DSS) 13 research and development station, Goldstone, CA, where it will be used to initiate the observational phase of the NASA SETI Sky Survey. It is anticipated that the early observations will be useful to test signal detection algorithms, scan strategies, and radio frequency interference rejection schemes. The SETI specific elements of the prototype system are: (1) the Wide Band Spectrum Analyzer (WBSA); a 2-million channel fast Fourier transformation (FFT) spectrum analyzer which covers an instantaneous bandpass of 40 MHz; (2) the signal detection processor; and (3) the SETI Sky Survey Manager, a network-based C-language environment that provides observatory control, performs data acquisition and analysis algorithms. A high level description of the prototype hardware and software systems will be given and the current status of the system development will be reported. Author

N92-13652*# California Univ., Berkeley. Space Sciences Inst.
THE SERENDIP 2 SETI PROJECT: CURRENT STATUS Abstract Only
C. S. Bowyer, D. Werthimer, C. Donnelly, W. Herrick, and M. Lampton *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 94 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Over the past 30 years, interest in extraterrestrial intelligence has progressed from philosophical discussion to rigorous scientific endeavors attempting to make contact. Since it is impossible to assess the probability of success and the amount of telescope time needed for detection, Search for Extraterrestrial Intelligence (SETI) Projects are plagued with the problem of attaining the large amounts of time needed on the world's precious few large radio telescopes. To circumvent this problem, the Search for Extraterrestrial Radio Emissions from Nearby Developed Intelligent Populations (SERENDIP) instrument operates autonomously in a piggyback mode utilizing whatever observing plan is chosen by the primary observer. In this way, large quantities of high-quality data can be collected in a cost-effective and unobtrusive manner. During normal operations, SERENDIP logs statistically significant events for further offline analysis. Due to the large number of terrestrial and near-space transmitters on earth, a major element of the SERENDIP project involves identifying and rejecting spurious signals from these sources. Another major element of the SERENDIP Project (as well as most other SETI efforts) is detecting extraterrestrial intelligence (ETI) signals. Events selected as candidate ETI signals are studied further in a targeted search program which utilizes between 24 to 48 hours of dedicated telescope time each year. Author

N92-13653*# Ohio State Univ., Columbus. Radio Observatory.
REOPTIMIZATION OF THE OHIO STATE UNIVERSITY RADIO TELESCOPE FOR THE NASA SETI PROGRAM
R. S. Dixon *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 95 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The Ohio State University radiotelescope is the second largest radio telescope in the United States, equivalent in collecting area (2200 sq m) to a 175-foot diameter dish. For the past 17 years it

has been dedicated fulltime to SETI, and it is now being considered by NASA for selection as the NASA dedicated SETI observatory. The telescope was originally designed, optimized, and used as an all-sky survey instrument to create detailed maps and catalogs of the radio astronomical sky. For the SETI Program, some re-optimizations are required. Right ascension tracking for one to two hours (depending on the declination) was achieved by exploiting the exceptionally large f/d ratio of the telescope. The feed horns were mounted on a large moveable, rubber-tired cart which is capable of a total motion of 100 feet. The cart can carry many horns, making possible simultaneous observations at many sky directions and frequency ranges. Rapid declination movement and its automation will be accomplished through simplification of the existing braking system, and replacement of older mechanical sensors by modern electronic inclinometers and proximity detectors. Circular polarization capability will be achieved through an increase in the number of horizontal wires in the reflector mesh, or addition of a finer mesh on top of the existing one. The telescope has great inherent resistance to radio frequency interference, due to its ground-mounted feed horns and shielding by the large reflectors of half the horizon. The resistance was recently increased further by installation of rolled-edges and diffraction-trapping gratings on the feed horns. If further shielding should be required, inexpensive side shields could be added to the telescope, making it a totally closed structure on all four sides. Author

N92-13654*# California Univ., Berkeley. Space Sciences Lab.
A DIRECTED SEARCH FOR EXTRATERRESTRIAL LASER SIGNALS Abstract Only **c91**
A. Betz *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 96 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

The focus of NASA's Search for Extraterrestrial Intelligence (SETI) Program is on microwave frequencies, where receivers have the best sensitivities for the detection of narrowband signals. Such receivers, when coupled to existing radio telescopes, form an optimal system for broad area searches over the sky. For a directed search, however, such as toward specific stars, calculations show that infrared wavelengths can be equally as effective as radio wavelengths for establishing an interstellar communication link. This is true because infrared telescopes have higher directivities (gains) that effectively compensate for the lower sensitivities of infrared receivers. The result is that, for a given level of transmitted power, the signal to noise ratio for communications is equally as good at infrared and radio wavelengths. It should also be noted that the overall sensitivities of both receiver systems are quite close to their respective fundamental limits: background thermal noise for the radio frequency system and quantum noise for the infrared receiver. Consequently, the choice of an optimum communication frequency may well be determined more by the achievable power levels of transmitters rather than the ultimate sensitivities of receivers at any specific frequency. In the infrared, CO2 laser transmitters with power levels greater than 1 MW can already be built on Earth. For a slightly more advanced civilization, a similar but enormously more powerful laser may be possible using a planetary atmosphere rich in CO2. Because of these possibilities and our own ignorance of what is really the optimum search frequency, a search for narrowband signals at infrared frequencies should be a part of a balanced SETI Program. Detection of narrowband infrared signals is best done with a heterodyne receiver functionally identical to a microwave spectral line receiver. We have built such a receiver for the detection of CO2 laser radiation at wavelengths near 10 microns. The spectrometer uses a high-speed HgCdTe diode as the photomixer and a small CO2 laser as the local oscillator. Output signals in the intermediate frequency range 0.1-2.6 GHz are processed by a 1000-channel acousto-optic signal processor. The receiver is being used on a 1.5-m telescope on Mt. Wilson to survey a selected sample of 150 nearby stars. The current status of the work is discussed along with future project plans. Author

N92-13655*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PLANETARY PROTECTION ISSUES AND HUMAN EXPLORATION OF MARS Abstract Only **c91**
D. L. DeVincenzi *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 99 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

A key feature of the Space Exploration Initiative involves human missions to Mars. The report describing the initiative cites the search for life on Mars, extant or extinct, as one of the five science themes for such an endeavor. Because of this, concerns for planetary protection (PP) have arisen of two fronts: (1) forward contamination of Mars by spacecraft-borne terrestrial microbes which could interfere with exobiological analyses; and (2) back contamination of Earth by species that may be present in returned Mars samples. The United States is also signatory to an international treaty designed to protect Earth and planets from harmful cross-contamination during exploration. Therefore, it is timely to assess the necessity for, and impact of, PP procedures on the mission set comprising the human exploration of Mars. The ground-rules adopted at a recent workshop which addressed PP questions of this type are presented. In addition, the workshop produced several recommendations for dealing with forward and back contamination concerns for non-scientific perspectives, including public relations, legal, regulatory, international, and environmental. Author

N92-13656*# Massachusetts Univ., Amherst.
ANALYSIS OF IMAGES OBTAINED BY THE PHOBOS 2 SPACECRAFT Abstract Only **c91**
W. M. Irvine *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 100 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

The reflection spectrum and density of the Martian satellite, Phobos, suggests that it may be a captured C-type asteroid and hence may contain relatively unaltered organic material from the early history of the solar system. Since there is evidence from isotopic anomalies that meteorites presumably derived from such asteroids contain preserved interstellar material, it is conceivable that evidence for interstellar matter might also be present on Phobos. The present research concerns interpretation of the chemical composition of Phobos' surface and analysis of images of Phobos taken by the FREGAT camera equipment aboard the Phobos 2 Spacecraft, including both disk-integrated and disk-resolved photometry. Because the surface of Phobos is a regolith, spectral information on the surface composition will be convolved with information on the surface texture. A primary goal was to untangle these effects. Unfortunately, the Phobos 1 Spacecraft lost contact with Earth during its transit to Mars, and Phobos 2 likewise lost contact after two months in orbit around Mars. Thus, the hovering phase of very close approach and the landing of instruments on the surface of Phobos did not take place, so no data on the elemental composition of the surface is available. However, 37 images were obtained of the satellite. The results include the first such observations at near infrared wavelengths, for which disk-integrated results show that the corresponding geometric albedo is quite small and very similar to the value in the blue. The resolved surface photometry was analyzed by developing new methods of radiative transfer in rough surface layers and a procedure referred to as statistical photoclinometry. The results provide root mean square surface slopes on scales from the order of 1 millimeter to 250 meters, albedo fluctuations, and corresponding correlation lengths.
Author

N92-13657*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TITAN AEROSOL AND GAS EXPERIMENT FOR THE HUYGENS PROBE Abstract Only **c91**
G. C. Carle, D. R. Kojiro, V. Oberbeck, B. J. OHara, J. B. Pollack, J. R. Valentin, A. Bar-Nun, M. J. Cohen, J. P. Ferris, and J. M.

Greenberg (Leiden Univ., Netherlands) et al *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 101 Prepared in cooperation with State Univ. of New York, Stony Brook (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

The Cassini Mission is a joint undertaking of NASA and the European Space Agency (ESA) to explore the Saturnian System with a Saturn Orbiter and a Titan Probe. The launch vehicle and the Saturn Orbiter are the responsibility of NASA while the Huygens Probe (detachable Titan Probe) is the responsibility of ESA. The spacecraft will be launched in 1996 and the Huygens Probe will arrive at Titan in 2003. The Cassini Mission-Huygens Probe provides a unique opportunity to obtain detailed information about the atmosphere and, possibly, the surface of Titan. Titan possesses a substantial nitrogen atmosphere containing methane and many other organic compounds. Aerosols play an important role in the atmospheric processes on Titan. The Huygens Probe offers an opportunity to determine how organic particles are formed and grow which will clarify their role on Earth. A powerful analytical instrument, capable of addressing the above technology and other science questions, was recently proposed for the Huygens Probe. It is comprised of an aerosol and gas sampler and processor, and a gas chromatograph-ion mobility spectrometer. The instrument will be able to measure complex organics that make up the collected aerosols to the approximate 1 ppm level. Gases will be measured to approximately 10 ppb. Because the Titan atmosphere is expected to be quite complex, a gas chromatograph-ion mobility spectrometer is used to provide unequivocal identification of the components of the analytes. Further details of the science question to be investigated and the proposed instrument are described. The expected results and their implications are also addressed.
Author

N92-13658*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANALYSIS OF MODEL TITAN ATMOSPHERIC COMPONENTS USING ION MOBILITY SPECTROMETRY Abstract Only c91
D. R. Kojiro, M. J. Cohen, R. F. Wernlund, R. M. Stimac, D. E. Humphry, and N. Takeuchi (TMA/Norcal, Richmond, CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 102 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

The Gas Chromatograph-Ion Mobility Spectrometer (GC-IMS) was proposed as an analytical technique for the analysis of Titan's atmosphere during the Cassini Mission. The IMS is an atmospheric pressure, chemical detector that produces an identifying spectrum of each chemical species measured. When the IMS is combined with a GC as a GC-IMS, the GC is used to separate the sample into its individual components, or perhaps small groups of components. The IMS is then used to detect, quantify, and identify each sample component. Conventional IMS detection and identification of sample components depends upon a source of energetic radiation, such as beta radiation, which ionizes the atmospheric pressure host gas. This primary ionization initiates a sequence of ion-molecule reactions leading to the formation of sufficiently energetic positive or negative ions, which in turn ionize most constituents in the sample. In conventional IMS, this reaction sequence is dominated by the water cluster ion. However, many of the light hydrocarbons expected in Titan's atmosphere cannot be analyzed by IMS using this mechanism at the concentrations expected. Research at NASA Ames and PCP Inc., has demonstrated IMS analysis of expected Titan atmospheric components, including saturated aliphatic hydrocarbons, using two alternate sample ionizations mechanisms. The sensitivity of the IMS to hydrocarbons such as propane and butane was increased by several orders of magnitude. Both ultra dry (waterless) IMS sample ionization and metastable ionization were successfully used to analyze a model Titan atmospheric gas mixture. Author

N92-13659*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A SILICONE COLUMN FOR GC ANALYSIS OF POLAR AND NONPOLAR CHEMICALS Abstract Only c91
T. C. Shen *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 103 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

The investigation of the Saturnian System is being proposed jointly by NASA and the European Space Agency (ESA). The mission is scheduled for a launch in 1996. The mission provides an opportunity for close observation and exploration of Saturn's atmosphere, the complex Saturnian System of satellites and rings, Titan (Saturn's planet-sized moon), and Saturn's magnetosphere. The mission gives special attention to Titan which is blanketed by a thick, opaque atmosphere. An atmospheric probe will be deposited into the Titan Atmosphere for in situ measurement during a slow, three hour descent to the surface. The results from this analysis may provide the information which is important to the research of chemical evolution, and the origin of life. An analytical system was developed as a part of the Titan Aerosol Gas Experiment (TAGEX), a proposed experiment for the Cassini Mission. This system will use two highly sensitive detectors, the Metastable Ionization Detector (MID) and the Ion Mobility Spectrometer (IMS). Unfortunately, when commercial columns are utilized with these highly sensitive detectors, volatile components continuously bleed from the column and interfere with the detector. In addition, light columns must be able to separate polar and nonpolar organic chemicals within 10-15 minutes under isothermal conditions for the Titan Mission. Therefore, a highly crosslinked silicone polymeric packed column was developed which is able to efficiently separate amines, alcohols, and hydrocarbons with retention times less that 15 minutes at 100 C isothermal condition.
Author

N92-13660*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
GAS CHROMATOGRAPHIC CONCEPTS FOR THE ANALYSIS OF PLANETARY ATMOSPHERES Abstract Only c25
J. R. Valentin, D. K. Cullers, K. W. Hall, R. L. Krekorian, and J. B. Phillips (University of Southern Illinois, Carbondale.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 104 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 07D

Over the last few years, new gas chromatographic (GC) concepts were developed for use on board spacecraft or any other restricted environments for determining the chemical composition of the atmosphere and surface material of various planetary bodies. Future NASA Missions include an entry probe that will be sent to Titan and various spacecraft that will land on Mars. In order to be able to properly respond to the mission science requirements and physical restrictions imposed on the instruments by these missions, GC analytical techniques are being developed. Some of these techniques include hardware and mathematical techniques that will improve GC sensitivity and increase the sampling rate of a GC descending through a planetary atmosphere. The technique of Multiplex Gas Chromatography (MGC) is an example of a technique that was studied in a simulated Titan atmosphere. In such an environment, the atmospheric pressure at instrument deployment is estimated to be a few torr. Thus, at such pressures, the small amount of sample that is acquired might not be enough to satisfy the detection requirements of the gas chromatograph. In MGC, many samples are pseudo-randomly introduced to the chromatograph without regard to elution of preceding components. The resulting data is then reduced using mathematical techniques such as cross-correlation of Fourier Transforms. Advantages realized from this technique include: improvement in detection limits of several orders of magnitude and increase in the number of analyses that can be conducted in a given period of time. Results proving the application of MGC at very low pressures emulating the same atmospheric pressures that a Titan Probe will encounter when the instruments

are deployed are presented. The sample used contained hydrocarbons that are expected to be found in Titan's atmosphere. In addition, a new selective modulator was developed to monitor water under Martian atmospheric conditions. Since this modulator is selective only to water, the need for a GC column is eliminated. This results in further simplification of the instrument. Author

N92-13661*# California Univ., San Diego, La Jolla. Dept. of Chemistry.

THE RELATIVE IMPORTANCE OF PREBIOTIC SYNTHESIS ON THE EARTH AND INPUT FROM COMETS AND METEORITES Abstract Only **c90**

S. L. Miller *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 105 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 03B

The prebiotic synthesis of hydrogen cyanide and formaldehyde was studied by the action of electric discharges on various model primitive atmospheres containing CH4, CO, and CO2. Photochemical production rates would also have been important and were calculated for HCN and H2CO. A reasonable rate of synthesis of amino acids from these sources is about 10 n moles/(sq cm yr) or 0.10 moles/sq cm in 10(exp 7) yrs. This would give a concentration of 3 x 10(exp -4) M in an ocean of the present size (300 liters/sq cm). The amino acids cannot accumulate over a longer period because the entire ocean passes through the 350 C submarine vents in 10(exp 7) yrs, which decomposes all the organic compounds. A number of workers have calculated the influx of comets and meteorites on the primitive earth, both as a destructive process for organic compounds and for any life that was present, as well as a source of organic compounds. Some of the amino acids from the meteorite proposed to have hit the earth 65 x 10(exp 6) yrs ago were detected at the Cretaceous/Tertiary boundary sediments. The problem with proposing a large scale input of organic compounds from meteorites and comets is that they must survive passage through the atmosphere and impact. There are some processes that would allow survival such as showers of centimeter to meter sized meteorites and various aerodynamic braking processes for larger objects. Even if a significant amount of the organic material survived impact, the destructive processes in the hydrothermal vents would remove these compounds on the average in 10(exp 7) yrs or less. If it is assumed that the input rate was sufficient to overcome these destructive processes, then too much carbon and water, especially from comets, would have been added to the surface of the earth. It was concluded that while some organic material was added to the earth from comets and meteorites, the amount available from these sources at a given time was only a few percent of that from earth based syntheses. Author

N92-13662*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LIFE ON ICE, ANTARCTICA AND MARS Abstract Only

D. T. Anderson, C. P. McKay, Robert A. Wharton, Jr., C. Sagan, S. W. Squyres, and G. M. Simmons (Virginia Polytechnic Inst. and State Univ., Blacksburg.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 108 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

The study of the origin of life and the prospects for human exploration of Mars are two themes developed in a new 57-minute film, Life on Ice, Antarctica, and Mars, produced by the InnerSpace Foundation and WHRO Television for broadcast by the Public Broadcasting System (PBS). A brief explanation of the film and how it relates to the future human exploration of space is presented. Author

N92-13663*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

IDENTIFICATION AND CHARACTERIZATION OF EXTRATERRESTRIAL NON-CHONDRITIC INTERPLANETARY DUST Abstract Only

D. F. Blake and R. H. Fleming (Evans, Charles and Associates, Redwood City, CA) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 109 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

Interplanetary dust particles (IDPs) are among the most pristine and primitive extraterrestrial materials available for direct study. Most of the stratospheric particles selected for study from the JSC Curatorial Collection were chondritic in composition (major element abundances within a factor of two of chondritic meteorites) because this composition virtually ensures that the particle is from an extraterrestrial source. It is likely that some of the most interesting classes of IDP's have not been recognized simply because they are not chondritic or do not fit established criteria for extraterrestrial origin. Indeed, mass spectroscopy data from the Giotto Flyby of comet Halley indicate that a substantial fraction of the dust is in the submicron size range and that a majority of these particles contain C, H, O, and/or N as major elements. The preponderance of CHON particles in the coma of Halley implies that similar particles may exist in the JSC stratospheric dust collection. However, the JSC collection also contains a variety of stratospheric contaminants from terrestrial sources which have these same characteristics. Because established criteria for extraterrestrial origin may not apply to such particles in individual cases, and integrated approach is required in which a variety of analysis techniques are applied to the same particle. Non-chondritic IDP's, like their chondritic counterparts, can be used to elucidate pre- and early solar system processes and conditions. The study of non-chondritic IDP's may additionally yield unique information which bears on the nature of cometary bodies and the processing of carbonaceous and other low atomic number materials. A suite of complementary techniques, including Low Voltage Scanning Electron Microscopy (LVSEM), Energy-Dispersive X-ray Microanalysis (EDX), Secondary Ion Mass Spectrometry (SIMS) isotope-ratio imaging and Analytical Electron Microscopy (AEM), were utilized to accomplish the following two objectives: (1) to develop criteria for the unequivocal identification of extraterrestrial non-chondritic IDP's; and (2) to infer IDP parent body, solar nebula, and pre-solar conditions through the study of phases, textures, and components contained within non-chondritic IDP's. The general approach taken is designed to maximize the total information obtained from each particle. Techniques will be applied in order from least destructive to most destructive. Author

N92-13664*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LDEF POST-RETRIEVAL EVALUATION OF EXOBIOLOGY INTERESTS Abstract Only

T. E. Bunch, F. RadicatIdiBrozolo, and Ray Fitzgerald (Diafin, La Jolla, CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 110 (For primary document see N92-13588 04-55)

Avail: NTIS HC/MF A07 CSCL 06C

Cursory examination of the Long Duration Exposure Facility (LDEF) shows the existence of thousands of impact craters of which less than 1/3 exceed 0.3 mm in diameter; the largest crater is 5.5 mm. Few craters show oblique impact morphology and, surprisingly, only a low number of craters have recognizable impact debris. Study of this debris could be of interest to exobiology in terms of C content and carbonaceous materials. All craters greater that 0.3 mm have been imaged and recorded into a data base by the preliminary examination team. Various portions of the LDEF surfaces are contaminated by outgassed materials from experimenters trays, in addition to the LDEF autocontamination and impact with orbital debris not of extraterrestrial origin. Because interplanetary dust particles (IDP's) nominally impacted the LDEF at velocities greater than 3 km/s, the potential for intact survival of carbonaceous compounds is mostly unknown for hypervelocity impacts. Calculations show that for solid phthalic acid (a test impactor), molecular dissociation would not necessarily occur below 3 km/s, if all of the impact energy was directed at breaking molecular bonds, which is not the case. Hypervelocity impact experiments (LDEF analogs) were performed using the Ames

Vertical Gun Facility. Grains of phthalic acid and the Murchison meteorite (grain diameter = 0.2 for both) were fired into an Al plate at 2.1 and 4.1 km/s respectively. The results of the study are presented, and it is concluded that meaningful biogenic elemental and compound information can be obtained from IDP impacts on the LDEF. Author

N92-13665*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
RECENT SPECTROSCOPIC FINDINGS CONCERNING CLAY/WATER INTERACTIONS AT LOW HUMIDITY: POSSIBLE APPLICATIONS TO MODELS OF MARTIAN SURFACE REACTIVITY Abstract Only
L. Coyne, J. Bishop, L. Howard, and T. W. Scattergood (State Univ. of New York, Stony Brook.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 111 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

A feasibility study assessing the utility of the adaptation of near infrared correlation spectroscopy to quantifying iron and adsorbed water in some clay-based Mars soil analog materials (MarSAM's). The work was intended to constitute Phase 1 of an approach to identifying optical analytical wavelength regions, not only for important mineral classes, but for chemically active centers within them. Many of these centers are common to unrelated mineral classes and of disproportionate influence relative to the mineral structure as a whole in determining the surface reactivity of mineral surfaces. We previously reported linearity between reflectance and total iron and total moisture over a large range of both key variables. We also discovered interesting relationships between the intensity of iron bands and the relative humidity of the systems. These relationships were confirmed. We also show that, in the low humidity range, reflectance is linearly dependent on a different kind of water from that best representing the full humidity range (the kind of water associated, in clays, with surface acidity). These relationships and the sensitivity and capability of quantitation of near infrared data indicate high promise with the production of reactive surface intermediates of products of surface reactions. Author

N92-13666*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CRYSTAL-FIELD-DRIVEN REDOX REACTIONS: HOW COMMON MINERALS SPLIT H2O AND CO2 INTO REDUCED H2 AND C PLUS OXYGEN Abstract Only
F. Freund, F. Batllo, R. C. LeRoy, S. Lersky, M. M. Masuda (San Jose State Univ., CA.), and S. Chang *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 112 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

It is difficult to prove the presence of molecular H2 and reduced C in minerals containing dissolved H2 and CO2. A technique was developed which unambiguously shows that minerals grown in viciously reducing environments contain peroxy in their crystal structures. The peroxy represent interstitial oxygen atoms left behind when the solute H2O and/or CO2 split off H2 and C as a result of internal redox reactions, driven by the crystal field. The observation of peroxy affirms the presence of H2 and reduced C. It shows that the solid state is indeed an unusual reaction medium. Author

N92-13667*# California Univ., Santa Cruz. Dept. of Chemistry.
KINETICS OF THE TEMPLATE-DIRECTED OLIGOMERIZATION OF GUANOSINE 5'-PHOSPHATE-2-METHYLIMIDAZOLIDE: EFFECT OF TEMPERATURE ON INDIVIDUAL STEPS OF REACTIONION Abstract Only
A. Kanavarioti, C. F. Bernasconi, and D. J. Alberas *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 113 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Non-enzymatic, template-directed reactions have been proposed as models for prebiological polynucleotide synthesis. Chemically activated mononucleotides react in the presence of a polynucleotide, acting as the template in a Watson-Crick base-pairing fashing, and form the complementary daughter polynucleotide. Phosphoimidazolide-activated nucleotides have been used successfully as substrates in these reactions. The kinetics of the guanosine 5'-monophosphate-2-methylimidazolide (2-MeImpG) reaction in aqueous pH 8.0 solutions in the presence and in the absence of polycytidylate (poly(C)) were studied, acting as the template at 6, 23, and 37 C. In the absence of the template, the major reaction pathway of 2-MeImpG is hydrolysis of the P-N bond to form the unreactive guanosine 5'-monophosphate (5'-GMP) and 2-methylimidazole. Concentrated solution of 2-MeImpG (greater than 0.02 M) in the absence of the template form only a small amount dinucleotide, (pG)2, but in the presence of poly(C), oligoguanylates, (pG)n with 2 less than or = n less than or = 40, can be detected. We were able to determine the rate constants for individual steps of this reaction. A summary of the conclusions is presented. Author

N92-13668*# Roswell Park Memorial Inst., Buffalo, NY. Dept. of Biophysics.
MACROMOLECULAR RECOGNITION: STRUCTURAL ASPECTS OF THE ORIGIN OF THE GENETIC SYSTEM
Robert Rein, W. Andrzej Sokalski, Dov Barak, Ning Luo, Theresa Julia Zielinski, and Masayuki Shibata *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 114 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Theoretical simulation of prebiotic chemical processes is an invaluable tool for probing the phenomenon of the evolution of life. Using computational and modeling techniques and guided by analogies from present day systems, we seek to understand the emergence of the genetic apparatus, enzymatic catalysis and protein synthesis under prebiotic conditions. Modeling of the ancestral aminoacyl-tRNA-synthetases (aRS) may provide important clues to the emergence of the genetic code and the protein synthetic machinery. The minimal structural requirements for the catalysis of tRNA aminoacylation are being explored. A formation of an aminoacyl adenylate was studied in the framework of ab initio molecular orbital theory. The role of individual residues in the vicinity of the TyrRS active site was examined, and the effect of all possible amino acids substitutions near the active site was examined. A formation of aminoacyl tRNA was studied by the molecular modeling system SYBYL with the high resolution crystallographic structures of the present day tRNA, aRS's complexes. The ultimate goal is to propose a simple RNA segment that is small enough to be build in the primordial chemical environment but maintains the specificity and catalytic activity of the contemporary RNA enzyme. To understand the mechanism of ribozyme catalyzed reactions, ab initio and semi-empirical (ZINDO) programs were used to investigate the reaction path of transphosphorylation. A special emphasis was placed on the possible catalytic and structural roles played by the coordinated magnesium cation. Both the inline and adjacent mechanisms of transphosphorylation were studied. The structural characteristics of the target helices, particularly a possible role for the G-T pair, is also studied by a molecular dynamics (MD) simulation technique. Author

N92-13669*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE 2.5-5.0 MICRON SPECTRA OF IO: EVIDENCE FOR H2S AND H2O FROZEN IN SO2 Abstract Only **c25**
F. Salama, L. J. Allamandola, F. C. Witteborn, D. P. Cruikshank, S. A. Sanford, and J. D. Bregman *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 115 Prepared in cooperation with National Academy of Sciences/National Research Council, Washington, DC (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 07D

The techniques of low temperature spectroscopy are applied to identify the constituents of the ices covering the surface of Io, a satellite of Jupiter. Infrared spectra of Io in the 4000-2000 cm exp -1 region, including new observational data, are analyzed using laboratory studies of plausible surface ices. Author

N92-13670*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LABORATORY SIMULATION OF THE PHOTOPROCESSING AND WARM-UP OF COMETARY AND PRE-COMETARY ICES: PRODUCTION OF COMPLEX ORGANIC MOLECULES Abstract Only **c90**
W. A. Schutte, L. J. Allamandola, and S. A. Sanford *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 116 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

The recent missions to Comet Halley detected large quantities of organic material on grains as well as organic molecules in the gas phase. A possible origin of these materials is the energetic processing of ice mantles on the grains prior to comet formation, either in the pre-solar nebula or the interstellar medium. This process was simulated in the laboratory by depositing interstellar ice analogs (H2O/CH3OH/CO/NH3) on a cold (10 K) substrate with simultaneous UV irradiation. The material evaporating during warm-up of the photolyzed ice as well as the residue remaining at room temperature was analyzed by a number of techniques. It was found that a large number of organic molecules of various complexity are synthesized during the simulation process, stressing the possible significance of UV photolysis for producing the organic Comet material. Author

N92-13671*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
BIOLOGICALLY CONTROLLED MINERALS AS POTENTIAL INDICATORS OF LIFE Abstract Only
D. E. Schwartz, R. L. Mancinelli, and E. Kaneshiro (Cincinnati Univ., OH.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 117 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Minerals can be produced and deposited either by abiotic or biologic means. Regardless of their origin, mineral crystals reflect the environment conditions (e.g., temperature, pressure, chemical composition, and redox potential) present during crystal formation. Biologically-produced mineral crystals are grown or reworked under the control of their host organism and reflect an environment different from the abiotic environment. In addition, minerals of either biologic or abiotic origin have great longevities. For these reasons, biologically produced minerals have been proposed as biomarkers. Biomarkers are key morphological, chemical, and isotopic signatures of living systems that can be used to determine if life processes have occurred. Studies of biologically controlled minerals produced by the protist, Paramecium tetraurelia, were initiated since techniques have already been developed to culture them and isolate their crystalline material, and methods are already in place to analyze this material. Two direct crystalline phases were identified. One phase, whose chemical composition is high in Mg, was identified as struvite. The second phase, whose chemical composition is high in Ca, has not been previously found occurring naturally and may be considered a newly discovered material. Analyses are underway to determine the characteristics of these minerals in order to compare them with characteristics of these minerals in order to compare them with characteristics of minerals formed abiotically, but with the same chemical composition. Author

N92-13672*# Arizona State Univ., Tempe. Center for the Study of Early Events in Photosynthesis.
PHOTOSYNTHETIC REACTION CENTER COMPLEXES FROM HELIOBACTERIA Abstract Only **c51**
J. T. Trost, W. F. J. Vermaas, and R. E. Blankenship *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 118 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 06C

Photosynthetic reaction centers are pigment-protein complexes that are responsible for the transduction of light energy into chemical energy. Considerable evidence indicates that photosynthetic organisms were present very early in the evolution of life on Earth. The goal of this project is to understand the early evolutionary development of photosynthesis by examining the properties of reaction centers isolated from certain contemporary organisms that appear to contain the simplest photosynthetic reaction centers. The major focus is on the family of newly discovered strictly anaerobic photosynthetic organisms that are grouped with the gram-positive phylum of bacteria. The properties of these reactions centers suggest that they may be the descendants of an ancestor that also gave rise to Photosystem 1 found in oxygen-evolving photosynthetic organisms. Photoactive reaction center-core antenna complexes were isolated from the photosynthetic bacteria, Heliobacillus mobilis and Heliobacterium gestii, by extraction of membranes with Deriphat 160C followed by differential centrifugation and sucrose density gradient centrifugation. Other aspects of this investigation are briefly discussed. Author

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-13673# General Accounting Office, Washington, DC. Information Management and Technology Div.
COMPUTER SECURITY: UNAUTHORIZED ACCESS TO A NASA SCIENTIFIC NETWORK. REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
Samuel W. Bowlin Nov. 1989 19 p
(GAO/IMTEC-90-2; B-233721) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

SPAN is a worldwide computer network linking computers used by scientists conducting NASA space and earth science research. Authorized users from almost anywhere in the world can connect to a computer on SPAN using a home computer and the public telephone system. NASA records show that between 1981 and March 1989, unauthorized users successfully gained access dozens of times to SPAN computers and used the network to gain access to other SPAN computers located at NASA and another Federal agency. Because SPAN was designed to facilitate the exchange of scientific information, NASA has to balance the desire for convenience and openness with the need to protect valuable scientific data from unauthorized users. NASA has taken or is in the process of taking some actions in response to the security incidents, but they have not performed a security risk analysis for SPAN, and therefore do not know the extent of the network's vulnerabilities or the kinds and level of security precautions that should be taken. The General Accounting Office (GAO) recommends that the NASA Administrator should: (1) ensure that a risk analysis of SPAN is performed and documented; (2)

ensure that NASA, in cooperation with the SPAN users, institutes the security measures developed as a result of the risk analysis; and (3) continue to report the computer security area as a material internal control weakness in this year's report to the President and the Congress, and discuss the actions that will be taken to correct the weakness. J.P.S.

N92-13674# Naval Postgraduate School, Monterey, CA.
REVISED GUIDANCE FOR THE ECONOMIC EVALUATION OF DOD DATA PROCESSING SYSTEMS M.S. Thesis
Robert G. Lang Sep. 1990 233 p
(AD-A241070) Avail: NTIS HC/MF A11 CSCL 12/7

Virtually every aspect of national defense involves computer support. Automation extents to logistics; financial management and administration; health care delivery; command, control, and communications; intelligence; tactical operations; and weapon systems. Because automation requires scarce time and resources, you must understand the available alternatives and their costs and benefits. Economic analysis gives you the tools you need to evaluate and compare the alternatives. Appendix E of this study gives you revised routines for doing an economic analysis. This guidance assumes that you are a novice in the field of economic analysis. Thus, the guidance develops material slowly, from a few very basic economic and common sense principles. While you can easily apply these techniques to many investment problems, this study limits the guidance to the economic problem of choice within the ADP arena. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-13675*# Spectra Research Systems, Inc., Huntsville, AL. Systems Technology Div.
ADVANCED PROGRAM DEVELOPMENT MANAGEMENT SOFTWARE SYSTEM. SOFTWARE DESCRIPTION AND USER'S MANUAL Final Report, 1 Apr. 1989 - 31 Mar. 1990
31 Mar. 1990 113 p
(Contract NAS8-36643)
(NASA-CR-184202; NAS 1.26:184202; SRS/STD-TR90-63; Rept-6670-12) Avail: NTIS HC/MF A06 CSCL 09B

The objectives of this project were to apply emerging techniques and tools from the computer science discipline of paperless management to the activities of the Space Transportation and Exploration Office (PT01) in Marshall Space Flight Center (MSFC) Program Development, thereby enhancing the productivity of the workforce, the quality of the data products, and the collection, dissemination, and storage of information. The approach used to accomplish the objectives emphasized the utilization of finished form (off-the-shelf) software products to the greatest extent possible without impacting the performance of the end product, to pursue developments when necessary in the rapid prototyping environment to provide a mechanism for frequent feedback from the users, and to provide a full range of user support functions during the development process to promote testing of the software. Author

N92-13676*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
CONJUGATE GRADIENT TYPE METHODS FOR LINEAR SYSTEMS WITH COMPLEX SYMMETRIC COEFFICIENT MATRICES
Roland Freund (Wuerzburg Univ., Germany, F.R.) Dec. 1989 29 p Presented at the Copper Mountain Conference on Iterative Methods, Copper Mountain, CO, 1-5 Apr. 1990
(Contract NCC2-387)
(NASA-CR-188893; NAS 1.26:188893; RIACS-TR-89-54) Avail: NTIS HC/MF A03 CSCL 09B

We consider conjugate gradient type methods for the solution of large sparse linear system Ax equals b with complex symmetric coefficient matrices A equals A(T). Such linear systems arise in important applications, such as the numerical solution of the complex Helmholtz equation. Furthermore, most complex non-Hermitian linear systems which occur in practice are actually complex symmetric. We investigate conjugate gradient type iterations which are based on a variant of the nonsymmetric Lanczos algorithm for complex symmetric matrices. We propose a new approach with iterates defined by a quasi-minimal residual property. The resulting algorithm presents several advantages over the standard biconjugate gradient method. We also include some remarks on the obvious approach to general complex linear systems by solving equivalent real linear systems for the real and imaginary parts of x. Finally, numerical experiments for linear systems arising from the complex Helmholtz equation are reported. Author

N92-13677*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
HUMAN ERROR AND THE SEARCH FOR BLAME
Peter J. Denning 29 Nov. 1989 8 p Submitted for publication
(Contract NCC2-387)
(NASA-CR-188904; NAS 1.26:188904; RIACS-TR-89-46) Avail: NTIS HC/MF A02 CSCL 09B

Human error is a frequent topic in discussions about risks in using computer systems. A rational analysis of human error leads through the consideration of mistakes to standards that designers use to avoid mistakes that lead to known breakdowns. The irrational side, however, is more interesting. It conditions people to think that breakdowns are inherently wrong and that there is ultimately someone who is responsible. This leads to a search for someone to blame which diverts attention from: learning from the mistakes; seeing the limitations of current engineering methodology; and improving the discourse of design. Author

N92-13678*# Alabama Univ., Huntsville.
A NATURAL LANGUAGE INTERFACE TO DATABASES Final Report
D. R. Ford Feb. 1990 36 p
(Contract NAS8-36955)
(NASA-CR-184222; NAS 1.26:184222; JRC-90-06) Avail: NTIS HC/MF A03 CSCL 09B

The development of a Natural Language Interface (NLI) is presented which is semantic-based and uses Conceptual Dependency representation. The system was developed using Lisp and currently runs on a Symbolics Lisp machine. Author

N92-13679*# Dynetics, Inc., Huntsville, AL.
USERS MANUAL FOR THE IMA PROGRAM Final Report
D. F. Williams Jan. 1991 60 p
(Contract NAS8-37850)
(NASA-CR-184241; NAS 1.26:184241; TR-91-NASA-37850-012)
Avail: NTIS HC/MF A04 CSCL 09B

The Impulsive Mission Analysis (IMA) computer program provides a user-friendly means of designing a complete Earth-orbital mission profile using an 80386-based microcomputer. The IMA program produces a trajectory summary, an output file for use by the new Simplex Computation of Optimum Orbital Trajectories (SCOOT) program, and several graphics, including ground tracks on a world map, altitude profiles, relative motion plots, and sunlight/communication timelines. The user can design missions using any combination of three basic types of mission segments: double co-eliptic rendezvous, payload delivery, and payload de-orbit/spacecraft recovery. Each mission segment is divided into one or more transfers, and each transfer is divided into one or more legs, each leg consisting of a coast arc followed by a burn arc. Author

N92-13680*# Dynetics, Inc., Huntsville, AL.
USERS MANUAL FOR THE IMA PROGRAM. APPENDIX C: PROFILE DESIGN PROGRAM LISTING Final Report
Jan. 1991 200 p
(Contract NAS8-37850)

(NASA-CR-184242; NAS 1.26:184242;
TR-91-NASA-37850-012-App-C) Avail: NTIS HC/MF A09
CSCL 09B

The source code for the Profile Design Program (PDP) for the Impulsive Mission Analysis (IMA) program is divided into several files. In a similar manner, the FORTRAN listings of the PDP's subroutines and function routines are organized into several groups in this appendix. Within each group, the FORTRAN listings are ordered alphabetically by routine name. Names and brief descriptions of each routine are listed in the same order as the Fortran listings. Author

N92-13681*# Inference Corp., Los Angeles, CA.
ART/Ada DESIGN PROJECT, PHASE 1 Final Report
Mar. 1989 138 p Prepared in cooperation with Houston Univ., Clear Lake, TX
(Contract NCC9-16; RICIS Proj. SE-19)
(NASA-CR-188939; NAS 1.26:188939) Avail: NTIS HC/MF A07
CSCL 09B

An Ada-Based Expert System Building Tool Design Research Project was conducted. The goal was to investigate various issues in the context of the design of an Ada-based expert system building tool. An attempt was made to achieve a comprehensive understanding of the potential for embedding expert systems in Ada systems for eventual application in future projects. The current status of the project is described by introducing an operational prototype, ART/Ada. How the project was conducted is explained. The performance of the prototype is analyzed and compared with other related works. Future research directions are suggested. Author

N92-13682# National Research Council of Canada, Ottawa (Ontario). Structures and Materials Lab.
IMAGE PROCESSING SYSTEM WITH SPECIAL ROUTINES FOR AUTOMATED ANALYSIS OF PHOTOELASTIC IMAGES: USER MANUAL
Michael Foster and Jerzy P. Komorowski 31 Jan. 1991 64 p
(NRC-ST-613; CTN-91-60277) Avail: NTIS HC/MF A04

The development of optical test methods, especially the use of photoelastic coatings (PEC), shadow Moire, and D-Sight methods, for use as composite testing and non-destructive inspection procedures is currently underway at the Structures and Materials Laboratory of the Institute for Aerospace Research. The Photoelastic Image Processing System is a PC based image processing software designed for the analysis of PEC images. This document is the user manual for the Photoelastic Image Processing System. The program, written in Microsoft C, creates, displays and stores enhanced imagery derived from PEC shear strain analysis and normal strain analysis. The software also has slide making, print making, and video image capture capabilities. CISTI

N92-13683# National Research Council of Canada, Ottawa (Ontario). Systems Lab.
GENERAL INFERENCE ENGINE FOR EXPERT SYSTEMS: USER'S GUIDE
S. Moran Nov. 1988 23 p
(NRC-29977; NRC-TR-Sys-019; CTN-91-60288) Copyright
Avail: NTIS HC/MF A03

An expert system is composed of a knowledge or rule base and a software module called an inference engine (IE) which applies a knowledge base to make judgements. The two main data structures used by the inference engine are the goal stack (GS) and the working storage (WS). The goal stack is a stack structure that contains the goals and subgoals which the IE must infer by using the rule base or querying the user. WS contains facts that have been inferred or provided by the user. This report is a manual for users of the General Inference Engine for Expert System (GIEES) implemented in PROLOG. GIEES has capabilities to explain its reasoning to accommodate uncertainties and to manage the knowledge base it uses for reasoning. GIEES comprises six modules for: command interpretation and dispatching, reasoning and inferencing, manipulation of knowledge bases, explanation or reasoning to the user, general support functions, and user help. CISTI

N92-13684# Technische Univ., Eindhoven (Netherlands).
SEMANTICS OF REACTIVE SYSTEMS: COMPARISON AND FULL ABSTRACTION Ph.D. Thesis
Cornelis Huizing 1991 134 p Sponsored in part by EEC (ETN-91-90306) Avail: NTIS HC/MF A07

A semantic basis for reactive systems from which methods of specification, verification, and ultimately, programming can be developed, is provided. The use of STATECHARTS as a language for reactive systems is discussed. For individual titles, see N92-13685 through N92-13689.

N92-13685# Technische Univ., Eindhoven (Netherlands).
EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT STATECHARTS BUT WERE AFRAID TO ASK
Cornelis Huizing and Willem Paul deRoever (Kiel Univ., Germany, F.R.) *In its* Semantics of Reactive Systems: Comparison and Full Abstraction 1991 p 9-22 Sponsored in part by BRA Project SPEC and Esprit (For primary document see N92-13684 04-61)
Avail: NTIS HC/MF A07

The notion of reactive systems is introduced and their difference from the more conventional transformational systems is explained. The graphical language STATECHARTS, as a description formalism for reactive systems, is introduced. The rationale behind design decisions of STATECHARTS is explained. ESA

N92-13686# Technische Univ., Eindhoven (Netherlands). Dept. of Mathematics and Computing Science.
FULL ABSTRACTION OF A REAL-TIME DENOTATIONAL SEMANTICS FOR AN OCCAM-LIKE LANGUAGE
Cornelis Huizing, Rob Gerth, and Willem Paul deRoever *In its* Semantics of Reactive Systems: Comparison and Full Abstraction 1991 p 25-57 Sponsored in part by Esprit Project 937 (For primary document see N92-13684 04-61)
Avail: NTIS HC/MF A07

A fully abstract semantics, for real time distributed computing of the Ada and OCCAM kind, is presented in a denotational style. This semantics turns termination, communication along channels, and the time communication takes place, into observables. Yet it is the coarsest semantics to do so which is syntax directed (this is known as full abstraction). It extends the linear history semantics for CSP of Francez, Lehman and Pnueli. The execution model is based on maximizing concurrent activity as opposed to interleaving (in which only one action occurs at the time and arbitrary delays are incurred between actions). It is a variant of the maximal parallelism model of Salwicki and Mueldner. ESA

N92-13687# Technische Univ., Eindhoven (Netherlands). Dept. of Mathematics and Computing Science.
MODELLING STATECHARTS BEHAVIOR IN A FULLY ABSTRACT WAY
Cornelis Huizing, Rob Gerth, and Willem Paul deRoever *In its* Semantics of Reactive Systems: Comparison and Full Abstraction 1991 p 61-100 Sponsored by Esprit Project 937 (For primary document see N92-13684 04-61)
Avail: NTIS HC/MF A07

A denotational, strictly syntax directed, semantics for STATECHARTS, a graphical, mixed specification/programming language for real time, developed by Harel, is presented. This requires first of all defining a proper syntax for the graphical language. Apart from more conventional syntactical operators and their semantic counterparts, conventional ones, dealing with the typical graphical structure of the language are encountered. The synchronous nature of STATECHARTS makes special demands on the semantics, especially with respect to the causal relation between simultaneous events, and requires a refinement of the techniques for obtaining a denotational semantics for OCCAM. The model is proved to be fully abstract with respect to some

natural notion of observable behavior. The model presented will serve as a basis for a further study of specification and proof systems within the ESPRIT project DESCARTES. ESA

N92-13688# Technische Univ., Eindhoven (Netherlands). Dept. of Mathematics and Computing Science.
ON THE SEMANTICS OF REACTIVE SYSTEMS
Cornelis Huizing and Rob Gerth *In its* Semantics of Reactive Systems: Comparison and Full Abstraction 1991 p 103-120 Sponsored in part by Esprit Projects 937 and 3096 (For primary document see N92-13684 04-61)
Avail: NTIS HC/MF A07

Real time reactive systems are explained to pose specific problems in defining languages to specify and program them. Three criteria are formulated, responsiveness, modularity, and causality, that are important to have for a high level specification language for these systems. These properties are proved to be uncombinable in one semantics. Since these properties are mandatory for a structured development of real time reactive systems, a two levelled semantics in which the three properties hold on different levels of the semantics is introduced: global events are treated more abstractly with respect to time than local events. ESA

N92-13689# Technische Univ., Eindhoven (Netherlands).
FORMALISMS RELATED TO STATECHARTS
Cornelis Huizing *In its* Semantics of Reactive Systems: Comparison and Full Abstraction 1991 p 123-128 (For primary document see N92-13684 04-61)
Avail: NTIS HC/MF A07

Several formalisms related to STATECHARTS as a language for reactive system are discussed. The use of ATP (Algebra of Timed Processes) for a more liberal treatment of timing is discussed. ESA

N92-13690*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
USER'S GUIDE FOR NETS/PROSSS
James L. Rogers and William J. LaMarsh, II (Unisys Corp., Hampton, VA.) Oct. 1991 31 p
(NASA-TM-104166; NAS 1.15:104166) Avail: NTIS HC/MF A03 CSCL 09B

Expensive analysis programs are often combined with optimization procedures to solve engineering problems. To obtain an optimal solution requires numerous iterations between the analysis program and the optimizer. This often becomes prohibitive due to the cost and amount of computer time needed to converge to an optimal solution. NETS/PROSSS was developed to address this problem. The purpose of this paper is to serve as a user's guide for NETS/PROSSS. The key features include the neural network, determining the training pairs for the neural network, and the approximated analysis/optimization process. A small problem is given to serve as an example of how to apply the system. Author

N92-13691# Houston Univ., TX.
CATALOGUE OF INTERFACE FEATURES AND OPTIONS FOR THE Ada RUNTIME ENVIRONMENT. RELEASE 3.0 Final Report
Jul. 1991 174 p
(AD-A240840) Avail: NTIS HC/MF A08 CSCL 12/7

This catalogue describes interface features and options for tailorable Ada runtime environments. Embedded systems in particular, often require scheduling regimens, pre-elaboration, fast interrupt handlers and other features that are not typically provided with compilers. The catalogue proposes common interfaces that address these issues. GRA

N92-13692# Colorado School of Mines, Golden. Center for Wave Phenomena.
A RECURSIVE ALGORITHM FOR COMPUTING RAY-PARAMETER DERIVATIVES Technical Report, 1 Oct. 1990 - 30 Sep. 1991
Zhenyue Liu 20 May 1991 7 p
(Contract N00014-91-J-1267)
(AD-A241005) Avail: NTIS HC/MF A02 CSCL 12/2

Under the assumption of high frequency, wave propagation can be described by the ray method. Many quantities in wave phenomena are characterized by some ray parameters and their derivatives. For example, the slope of arrival time-offset curve is characterized by the emergence angle of a ray; the curvature is characterized by derivative of that angle, and the amplitude of the signal is characterized by the derivative of the taking-off angle. In this paper, we give a recursive algorithm for ray-parameter derivatives, when the medium is made up of constant-velocity layers separated by arbitrary, smooth interfaces. The algorithm uses derivatives of interfaces, intersection points of rays with the interfaces, and angles of incidence and transmission, all of which are easily computed. A conclusion of these formulas is that no ray caustic exists for transmission or for the reflection from any one of the reflectors when the interfaces are flat. GRA

N92-13693# Colorado School of Mines, Golden. Center for Wave Phenomena.
SMOOTHING OF NONUNIFORMLY-SPACED DATA Technical Report, 1 Oct. 1990 - 30 Sep. 1991
Zhenyue Liu 20 May 1991 8 p
(Contract N00014-91-J-1267)
(AD-A241006) Avail: NTIS HC/MF A02 CSCL 12/3

This paper introduced a smoothing technique for an experimental curve. This method is not restricted by uniform sampling, and smooths a curve efficiently. A key step in practice is how to choose a suitable smoothing parameter. This depends on the properties of the problem to be solved. In the example of my application, I chose the smoothing parameter such that the travel time is preserved and the amplitude distribution becomes smoother. GRA

N92-13694# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
ALGORITHMS FOR SCHEDULING AND NETWORK PROBLEMS Ph.D. Thesis
Joel M. Wein Sep. 1991 136 p
(Contract N00014-89-J-1988)
(AD-A241225; MIT/LCS/TR-514) Avail: NTIS HC/MF A07 CSCL 12/2

In this thesis we develop algorithms for two basic classes of problems in combinatorial optimization: deterministic machine scheduling and network optimization. In the first part of the thesis we consider approximation algorithms for two basic scheduling environments: shop scheduling and parallel machine scheduling. We give approximation algorithms for shop scheduling that significantly improve upon the performance of previous algorithms. We then study on-line approximation algorithms for parallel machine scheduling. In the second part of the thesis we present several theoretical and practical results about parallel algorithms for network optimization problems. GRA

N92-13695# Naval Postgraduate School, Monterey, CA.
DESIGN AND IMPLEMENTATION OF AN INTELLIGENT COST ESTIMATION MODEL FOR DECISION SUPPORT SYSTEM SOFTWARE M.S. Thesis
William E. Blazer Sep. 1990 126 p
(AD-A241322) Avail: NTIS HC/MF A07 CSCL 05/3

Recently, Decision Support Systems (DSS) have increased in importance and usage. However, these increases have not carried over into developing better models to estimate the real cost of developing the DSS. This thesis explores various estimation methods that seem pertinent to DSS. It advocates the use of a combination of modeling tools particularly tailored to the users' environment. An Intelligent Cost Estimation Model (ICEM) for Decision Support System software is proposed. To promote user-friendliness, ICEM uses a rule based front end interface coupled to a spreadsheet program. For comparison purposes the current version of ICEM includes the Intermediate COCOMO model,

the Intermediate COCOMO model particularly calibrated for the in-house DSS development environment, and a parametric model which incorporates the function point size metric. GRA

N92-13696# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
BEYOND KEYFRAMING: AN ALGORITHMIC APPROACH TO ANIMATION
A. J. Stewart and James F. Cremer May 1991 19 p
(AD-A241337; TR-91-1207) Avail: NTIS HC/MF A03 CSCL 12/9

The recent explosion of interest in physical system simulation may soon lead to realistic animation of passive objects, such as sliding blocks or bouncing balls. However, complex active objects (like human figures and insects) need a control mechanism to direct their movements. We present a paradigm that combines the advantages of physical simulation and algorithmic specification of movement. The animator writes an algorithm to control the object and runs this algorithm on a physical simulator to produce the animation. Algorithms can be reused or combined to produce complex sequences of movements, eliminating the need for tedious keyframing. We have applied this paradigm to control a walking biped. The walking algorithm is presented along with the results from testing with the Newton simulation system. GRA

N92-13697# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
ALGORITHMS FOR SEARCH TREES ON MESSAGE-PASSING ARCHITECTURES
Eric A. Brewer, Chrysanthos N. Dellarocas, Adrian Colbrook, and William E. Weihl Sep. 1991 31 p
(Contract N00014-89-J-1988; NSF CCR-87-16884)
(AD-A241344; MIT/LCS/TR-517) Avail: NTIS HC/MF A03 CSCL 12/6

This paper describes a new algorithm for maintaining a balanced search tree on a message-passing MIMD architecture; the algorithm is particularly well suited for implementation on a small number of processors. We introduce a search tree that uses a linear array of processors to store n entries. Update operations use a bottom-up node-splitting scheme, which performs better than top-down search tree algorithms. Additionally, for a given cost ratio of computation to communication the value of B may be varied to maximize performance. Implementations on a parallel-architecture simulator are described. GRA

N92-13698# Naval Postgraduate School, Monterey, CA.
DESIGN AND IMPLEMENTATION OF A PRIMAL SIMPLEX NETWORK OPTIMIZER IN C M.S. Thesis
Keith D. Solveson Sep. 1990 61 p
(AD-A241350) Avail: NTIS HC/MF A04 CSCL 12/5

This thesis documents the design and implementation of an efficient primal simplex capacitated transshipment network optimizer, SNET, written in the C programming language. It describes a general symbolic network algorithm, discusses fundamental decisions regarding data structures and essential functions and their relationship to the network algorithm, and then details SNET's development. Development tools used in this project, including standard test problems, profilers, timing routines, external drivers, and debuggers, are also covered. The resulting solver, SNET, is quite fast on standard NETGEN test problems, approximately twice as fast as a primal simplex network solver written in FORTRAN. The effect of tuning parameters on SNET's performance is minimal. GRA

N92-13699# Washington Univ., Seattle. Dept. of Statistics.
MODEL SELECTION AND ACCOUNTING FOR MODEL UNCERTAINTY IN GRAPHICAL MODELS USING OCCAM'S WINDOW
David Madigan and Adrian E. Raftery 22 Jul. 1991 35 p
(Contract N00014-88-K-0265)
(AD-A241408; TR-213) Avail: NTIS HC/MF A03 CSCL 12/3

We consider the problem of model selection and accounting for model uncertainty in high-dimensional contingency tables, motivated by expert system applications. The approach most used currently is a stepwise strategy guided by tests based on approximate asymptotic P-values leading to the selection of a single model; inference is then conditional on the selected model. The sampling properties of such a strategy are complex, and the failure to take account of model uncertainty leads to underestimation of uncertainty about quantities of interest. In principle, a panacea is provided by the standard Bayesian formalism which averages the posterior distributions of the quantity of interest under each of the models, weighted by their posterior model probabilities. However, this has not been used in practice because computing the posterior model probabilities is hard and the number of models is very large. We argue that the standard Bayesian formalism is unsatisfactory and we propose an alternative Bayesian approach that, we contend, takes full account of the true model uncertainty by averaging over a much smaller set of models. GRA

N92-13700# Society for Industrial and Applied Mathematics, Philadelphia, PA.
SIAM WORKSHOP ON AUTOMATIC DIFFERENTIATION OF ALGORITHMS: THEORY, IMPLEMENTATION AND APPLICATION Final Report
I. E. Block 1 Jan. 1991 10 p Workshop held in Breckenridge, CO, 6-9 Jan. 1990
(Grant AF-AFOSR-0004-91; AF Proj. 2304)
(AD-A241512; AFOSR-91-0811TR) Avail: NTIS HC/MF A02 CSCL 05/2

The workshop was attended by sixty-five researchers, of whom thirty gave half hour lectures, and nineteen presented posters. This was the first scientific meeting devoted to the topic of automatic differentiation of algorithms. There were many excellent talks on large scale applications - in particular weather modeling, oceanography, petroleum reservoir modeling, beam tracing in optics, satellite orbit analysis, and mechanical systems simulation. Some of the speakers delineated very clearly the remaining deficiencies of currently available automatic differentiation techniques in comparison to handcoded derivative evaluation programs. From the lively discussion that followed, it can be expected that the software developers present will accept the challenge of closing this gap in efficiency without sacrificing user convenience. In many formal and informal discussions, the participants raised the question of how potential users and the scientific community at large can be made aware of the extremely promising computational techniques presented at the workshop. Some felt that the name Automatic Differentiation sounds too mechanical and fails to indicate the wealth of intrinsic problems and ramifications. GRA

N92-13701# Southwest Research Inst., San Antonio, TX.
COMPUTER-AIDED ENGINEERING (CAE) TOOL ASSESSMENT/DEVELOPMENT Final Report, Sep. 1989 - Sep. 1990
Joseph N. Barfield, John Lilley, and Kim Barclay Sep. 1990 117 p
(Contract F19628-89-C-0207)
(AD-A241556; GL-TR-90-0296) Avail: NTIS HC/MF A06 CSCL 22/2

Computer Aided Engineering (CAE) tools in use by Spacecraft Designers are assessed by means of a distributed survey. The types of tools in use, the computer platforms and peripherals used, and the extent to which the tools are used are assessed. ESABASE is examined as a prototype integrated CAE package. Recommendations are made for future CAE tool development. The spacecraft designer faces a number of significant challenges that are unique to his field. The spacecraft designer must account for environmental rigors that are either unknown or insignificant at the earth's surface. In addition to creating a component or system to perform a specific function, the spacecraft designer must ensure that it will operate properly in the hostile space environment. The system must be thoroughly checked out to verify that it will survive and operate successfully in space and that the many possible interactions between the spacecraft and its environment are each either suppressed or made benign. GRA

N92-13702# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
MODELS FOR UNDERGRADUATE PROJECT COURSES IN SOFTWARE ENGINEERING Final Report
Mary Shaw and James E. Tomayko Aug. 1991 80 p
(Contract F19628-90-C-0003)
(AD-A241780; CMU/SEI-91-TR-10; CMU-CS-91-174; ESD-TR-91-10) Avail: NTIS HC/MF A05 CSCL 12/5

The software engineering course provides undergraduates with an opportunity to learn something about real-world software development. Since software engineering is far from being a mature engineering discipline, it is possible to define a completely satisfactorily syllabus. Content with sound basis in short supply, and the material often taught is at high risk of becoming obsolete within a few years. Undergraduate software engineering courses are now offered in more than a hundred universities. Although three textbooks dominate the market, there is not yet consensus on the scope and form of the course. The two major decisions an instructor faces are the balance between technical and management topics and the relation between the lecture and project components. We discuss these two decisions, with support from sample syllable and survey data on course offerings in the United States and Canada. We also offer some advice on the management of a project-oriented course. GRA

N92-13703# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
MEASUREMENT IN PRACTICE
Stan Rifkin and Charles Cox Jul. 1991 80 p
(Contract F19628-89-C-0003)
(AD-A241781; CMU/SEI-91-TR-16; ESD-TR-91-16) Avail: NTIS HC/MF A05 CSCL 12/5

The Software Engineering Institute (SEI) Software Process Program encourages the use of measurement to aid the management of software development and maintenance. As part of our encouragement, we seek to expose software practitioners and managers to the greatest benefits and best operation of measurement programs. Measurement is critical to the software process maturity framework promulgated by the SEI, and this relationship provided additional impetus to collect excellent measurement practices. A few organizations have reputations for implementing excellent software measurement practices. A sample of these organizations was surveyed in site visits. Clear patterns of practices emerged and they are reported at a consolidated, lessons learned level and in more detailed case studies. GRA

N92-13704# Clark-Atlanta Univ., GA.
ANALYSIS OF ACTIVE CONTROLLER EFFECTS ON FLEXIBLE STRUCTURES USING COMPUTER ALGEBRA Final Report, 1 Jul. 1989 - 30 Jun. 1991
Kwabena Bota 23 Aug. 1991 40 p
(Contract F49620-89-C-0075)
(AD-A241847; AFOSR-91-0888TR) Avail: NTIS HC/MF A03 CSCL 13/13

The combined system consisting of the baseline flexible structure modified by the system of active controllers is considered as a unified dynamical system. Techniques based on computer algebra (MACSYMA) are used to derive expressions for the transfer functions of the modified system, using the known transfer functions of the baseline flexible structure and the feedback gains of the active controller. The roots of the characteristics polynomial of this transfer function give the system resonant frequencies and damping parameters. Using the computer algebraic system MACSYMA, expressions for these parameters which are explicitly dependent on the output feedback gains of the active controller, are presented. For lightly coupled modes, simple relations are obtained between the modal parameters and the coordinates of the sensor/actuator pairs as well as the displacement and velocity feedback gains. These results permit the parametric study of the placement of the resonant frequencies and damping parameters of the combined system, as functions of the feedback gains. Numerical examples are used to illustrate the application of these results to the calculation of active controller feedback gains based on the requirement that certain modes have specified modal damping while the closed-loop frequencies remain unchanged. GRA

N92-13705# Sandia National Labs., Albuquerque, NM.
COMPILE-TIME PARTITIONING OF A NON-STRICT LANGUAGE WITH SIDE-EFFECTS INTO SEQUENTIAL THREADS
J. E. Hoch, D. M. Davenport, V. G. Grafe, and K. M. Steele 1991 21 p Presented at the 3rd Institute of Electrical and Electronic Engineers (IEEE) Symposium on Parallel and Distributed Processing, Dallas, TX, 1 Dec. 1991
(Contract DE-AC04-76DP-00789)
(DE91-013107; SAND-91-1252C; CONF-911230-1) Avail: NTIS HC/MF A03

This paper presents a practical algorithm for partitioning a program into sequential threads. A thread is a sequence of instructions, possibly including branches, which can be scheduled as an indivisible unit on a von Neumann-like processor. The partitioning algorithm is designed for a non-strict (but not lazy) language with non-strict data structures and side-effects. The primary target of the proposed compilation strategy is large-scale parallel systems which rely on multithreading at the processor level to tolerate long communication latencies. As such, the algorithm incorporates a mechanism to balance the desire to maximize thread length with the desire to expose useful high-level parallelism. Although this paper focuses on non-strict semantics in conjunction with a parallel multithreaded architecture, the partitioning analysis is equally well suited (with appropriate simplifications) to a non-strict language on a sequential machine or a strict language on a parallel multithreaded machine. Our analysis is accomplished without compromising non-strict semantics and without creating dependencies which sacrifice useful high-level parallelism. It can also exploit known dependency information. The analysis starts with a traditional dataflow graph and partitions it into a set of interrelated threads. DOE

N92-13706# Lawrence Livermore National Lab., CA.
IMPLEMENTING FUNCTIONAL LANGUAGES TO EXPLOIT LOCALITY
R. Wolski, J. Feo, and D. Cann 1991 21 p Presented at the 3rd Institute of Electrical and Electronic Engineers (IEEE) Symposium on Parallel and Distributed Processing, Dallas, TX, 1 Dec. 1991
(Contract W-7405-eng-48)
(DE91-015121; UCRL-JC-107491; CONF-911230-2) Avail: NTIS HC/MF A03

In the quest for high performance, no obstacle has been as persistent or unyielding as memory latency. It was hoped that dataflow's fine-grain asynchronous model of execution might defeat the memory latency problem. Unable to realize efficient fine-grain systems, the dataflow community is now studying medium-grain and coarse-grain implementations which, like conventional execution models, suffer the effects of memory latency. In this paper, we describe a functional language implementation that automatically exploits locality on cache-coherent multiprocessors. Our system achieves performance improvements reaching 20 percent for some programs. This study lends further support to the superiority of the functional paradigm for parallel processing. DOE

N92-13707# International Centre for Theoretical Physics, Trieste (Italy).
AN EFFICIENT CONTROL ALGORITHM FOR NONLINEAR SYSTEMS
S. Sinha Dec. 1990 10 p
(DE91-633964; IC-90/435) Avail: NTIS HC/MF A02

We suggest a scheme to step up the efficiency of a recently proposed adaptive control algorithm, which is remarkably effective for regulating nonlinear systems. The technique involves monitoring of the stiffness of control to get maximum gain while maintaining a predetermined accuracy. The success of the procedure is

demonstrated for the case of the logistic map, where we show that the improvement in performance is often factors of tens, and for small control stiffness, even factors of hundreds. DOE

N92-13835*# University of South Florida, Tampa. Dept. of Civil Engineering and Mechanics.
COMPARISON OF POLYNOMIAL APPROXIMATIONS AND ARTIFICIAL NEURAL NETS FOR RESPONSE SURFACES IN ENGINEERING OPTIMIZATION
William C. Carpenter *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 68-80 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09B

N92-13851*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
IMPLEMENTATION OF THE LANCZOS EIGEN-SOLVER FOR THE CSI CODE ON HIGH PERFORMANCE COMPUTERS
Duc T. Nguyen *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 163-168 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09B

N92-13869*# Polytechnic Univ., Brooklyn, NY. Dept. of Civil Engineering.
OBJECT ORIENTED DEVELOPMENT OF ENGINEERING SOFTWARE USING CLIPS
C. John Yoon *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 248-249 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-13708# Ames Lab., IA.
SIGNAL PROCESSING ALGORITHMS ON PARALLEL ARCHITECTURES: A PERFORMANCE UPDATE
D. Rover, V. Tsai, Yin-Shan Chow, and J. Gustafson Feb. 1991 15 p Previously announced in IAA as A91-55594
(Contract W-7405-eng-82)
(DE92-000525; IS-5055) Avail: NTIS HC/MF A03

The Burg algorithm is a widely applied and extensively studied signal processing procedure having a structure typical of a class of important batch signal processing algorithms. Its implementation and performance on four different parallel machines were reported in the 1990 Journal of Parallel and Distributed Computing Special Issue on Massively Parallel Computation. The machines were: the Intel iPSC/2, the Denelcor HEP, the NASA/Goodyear MPP, and the Cray X-MP/48. The objective of the work reported here was to extend that study to two new parallel machines: the nCUBE 2 and the MasPar MP-1. These computers are related to the distributed memory systems above (i.e., the iPSC and the MPP, respectively), but use newer technology. In addition to achieving significant performance gains on the new machines compared to machines in the same architectural class, we found that the original study underestimated the scaleability of the algorithm. That is, the algorithm maps efficiently to small-scale as well as large-scale computers, including both SIMD and MIMD distributed memory systems. Improvements in the parallel algorithm are highlighted. Of special import is the use of appropriate performance metrics and performance visualization to characterize the parallelism of the algorithm and lend insight toward understanding and evaluating its performance. DOE

N92-13709*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
PUTTING TIME INTO PROOF OUTLINES
Fred B. Schneider, Bard Bloom, and Keith Marzullo Sep. 1991 23 p Sponsored in part by IBM and Siemens Corp.
(Contract NAG2-593; N00014-91-J-1219; NSF CCR-87-01103; NSF CCR-90-14363; NSF CCR-90-03441)
(NASA-CR-189500; NAS 1.26:189500; TR-91-1238) Avail: NTIS HC/MF A03 CSCL 09B

A logic for reasoning about timing of concurrent programs is presented. The logic is based on proof outlines and can handle maximal parallelism as well as resource-constrained execution environments. The correctness proof for a mutual exclusion protocol that uses execution timings in a subtle way illustrates the logic in action. Author

N92-13710*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
MAINTAINING CONSISTENCY IN DISTRIBUTED SYSTEMS
Kenneth P. Birman 12 Nov. 1991 38 p Sponsored in part by IBM; HP; Siemens Corp.; GTE; and Hitachi Ltd.
(Grant NAG2-593)
(NASA-CR-189504; NAS 1.26:189504; TR-91-1240) Avail: NTIS HC/MF A03 CSCL 09B

In systems designed as assemblies of independently developed components, concurrent access to data or data structures normally arises within individual programs, and is controlled using mutual exclusion constructs, such as semaphores and monitors. Where data is persistent and/or sets of operation are related to one another, transactions or linearizability may be more appropriate. Systems that incorporate cooperative styles of distributed execution often replicate or distribute data within groups of components. In these cases, group oriented consistency properties must be maintained, and tools based on the virtual synchrony execution model greatly simplify the task confronting an application developer. All three styles of distributed computing are likely to be seen in future systems - often, within the same application. This leads us to propose an integrated approach that permits applications that use virtual synchrony with concurrent objects that respect a linearizability constraint, and vice versa. Transactional subsystems are treated as a special case of linearizability. Author

N92-13711# Toledo Univ., OH. Dept. of Electrical Engineering.
DEVELOPMENT OF PARALLEL ARCHITECTURES FOR SENSOR ARRAY PROCESSING ALGORITHMS Semiannual Report
M. M. Jamali, S. C. Kwatra, Abdelhamid Djoudi, Rajesh Sheelvant, and Manoj Rao Aug. 1991 112 p
(AD-A240869) Avail: NTIS HC/MF A06 CSCL 12/3

The high resolution direction of arrival (DOA) estimation has been an important area of research for a number of years. Many researchers have developed a variety of algorithms to estimate the direction of arrival. Another important aspect of the DOA estimation area is the development of high speed hardware capable of computing the DOA in real time. In this research, we have first focussed on the development of parallel architecture for multiple signal classification (MUSIC) and estimation of signal parameters by rotational invariance technique (ESPRIT) algorithms for the narrow band sources. These algorithms are substituted with computationally efficient modules and converted to pipelined and parallel algorithms. For example one important computation of eigendecomposition of the covariance matrix has been performed using Householders transformations and QR method. GRA

N92-13712# Georgia Inst. of Tech., Atlanta. Computer Engineering Research Lab.
GUIDANCE, NAVIGATION AND CONTROL. DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 3, PART 1, TASK 3: SPECIAL STUDIES Annual Report, period ending FY 1991
Cecil O. Alford, Richard M. Pitts, and Philip R. Bingham 27 Sep. 1991 57 p
(Contract DASG60-89-C-0142)
(AD-A240945; AR-0142-91-002-Vol-3-Pt-1) Avail: NTIS HC/MF A04 CSCL 12/5

Information is given on contract interfaces, technical issues,

and parallel programming methodology. Information is given in appendix A on EXOSIM V1.0 Boost Phase; Part 3-(7); and in appendix B on EXOSIM V2.0 Midcourse/Terminal Phase. GRA

N92-13713# Georgia Inst. of Tech., Atlanta. Computer Engineering Research Lab.
GUIDANCE, NAVIGATION AND CONTROL. DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 3, PART 2, TASK 3: SPECIAL STUDIES Annual Report, period ending FY 1991
Cecil O. Alford, Richard M. Pitts, and Philip R. Bingham 27 Sep. 1991 104 p
(Contract DASG60-89-C-0142)
(AD-A240946; AR-0142-91-002-Vol-3-Pt-2) Avail: NTIS HC/MF A06 CSCL 12/5

Given here are an introduction, contract interfaces, technical issues, and parallel programming methodology relative to guidance, navigation, and control. Information is given in appendix A on Exosim v1.0 Boost Phase; Part 3-(7); and in appendix B on EXOSIM V2.0 Midcourse/Terminal Phase. GRA

N92-13714# Georgia Inst. of Tech., Atlanta. Computer Engineering Research Lab.
GUIDANCE, NAVIGATION AND CONTROL. DIGITAL EMULATION TECHNOLOGY LABORATORY. VOLUME 3, PART 3, TASK 3: SPECIAL STUDIES Annual Report, period ending FY 1991
Cecil O. Alford, Richard M. Pitts, and Philip R. Bingham 27 Sep. 1991 267 p
(Contract DASG60-89-C-0142)
(AD-A240947; AR-0142-91-002-Vol-3-Pt-3) Avail: NTIS HC/MF A12 CSCL 12/5

Information is given on contract interfaces, technical issues, and parallel programming methodology regarding guidance, navigation, and control. Information is given in appendix A on EXOSIM V1/0 Boost Phase; Part 3-(7); and in appendix B on EXOSIM V2.0 Midcourse/Technical Phase. GRA

N92-13715# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
PROTEUS: A HIGH-PERFORMANCE PARALLEL-ARCHITECTURE SIMULATOR
Eric A. Brewer, Chrysanthos N. Dellarocas, Adrian Colbrook, and William E. Weihl Sep. 1991 29 p
(Contract N00014-89-J-1988; NSF CCR-87-16884)
(AD-A241343; MIT/LCS/TR-516) Avail: NTIS HC/MF A03 CSCL 12/5

PROTEUS is a high-performance simulator for MIMD multiprocessors. It is fast, accurate, and flexible: it is one to two orders of magnitude faster than comparable simulators, it can reproduce results from real multiprocessors, and it is easily configured to simulate a wide range of architectures. PROTEUS provides a modular structure that simplifies customization and independent replacement of parts of architecture. There are typically multiple implementations of each module that provide different combinations of accuracy and performance; users pay for accuracy only when and where they need it. Finally, PROTEUS provides repeatability, nonintrusive monitoring and debugging, and integrated graphical output, which result in a development environment superior to those available on real multiprocessors. GRA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-13716 Yale Univ., New Haven, CT.
EXACT ROBOT NAVIGATION USING ARTIFICIAL POTENTIAL FUNCTIONS Ph.D. Thesis
Elon Rimon 1990 211 p
Avail: Univ. Microfilms Order No. DA9122292

The use of artificial potential functions to solve to robot navigation problem is examined in the context of perfect information. A class of potential function, the navigation functions, is defined and shown to represent an exact solution to the problem. Essentially, these functions must have a unique minimum at the destination, be uniformly maximal on the obstacles' boundary, and be sufficiently smooth. Once a navigation function is constructed for a given obstacle course and desired destination, there is a natural and automatic way to derive from it a bounded-torque feedback control law for the robot. The resulting closed-loop robot system is guaranteed to approach the desired destination without hitting the obstacles. This methodology constitutes the only probably correct and, in principle, completely general alternative to the currently used method of first planning a collision-free path and then forcing the robot to follow it. Several theoretical insights concerning the expressive capability of potential functions are derived. Navigation functions are constructed on n-dimensional Euclidean sphere worlds, representing ideal obstacle course for a point-mass robot. The Euclidean sphere worlds serve as a model for their topological equivalence class. Navigation functions on the geometrically complicated spaces in this topological class are then constructed by pulling back a suitable prior construction on the corresponding model space via coordinate transformation. Dissert. Abstr.

N92-13717*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN SSME HIGH PRESSURE OXIDIZER TURBOPUMP DIAGNOSTIC SYSTEM USING G2(TM) REAL-TIME EXPERT SYSTEM
Ten-Huei Guo Nov. 1991 14 p Presented at the Third Annual Health Monitoring Conference for Space Propulsion Systems, Cincinnati, OH, 13-14 Nov. 1991; sponsored by the Univ. of Cincinnati
(NASA-TM-105328; E-6689; NAS 1.15:105328) Avail: NTIS HC/MF A03 CSCL 09B

An expert system which diagnoses various seal leakage faults in the High Pressure Oxidizer Turbopump of the SSME was developed using G2(TM) real-time expert system. Three major functions of the software were implemented: model-based data generation, real-time expert system reasoning, and real-time input/output communication. This system is proposed as one module of a complete diagnostic system for Space Shuttle Main Engine. Diagnosis of a fault is defined as the determination of its type, severity, and likelihood. Since fault diagnosis is often accomplished through the use of heuristic human knowledge, an expert system based approach was adopted as a paradigm to develop this diagnostic system. To implement this approach, a software shell which can be easily programmed to emulate the human decision process, the G2 Real-Time Expert System, was selected. Lessons learned from this implementation are discussed. Author

N92-13718# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
INTELLIGENCE WITHOUT REASON
Rodney A. Brooks Apr. 1991 29 p
(Contracts N00014-86-K-0685; N00014-85-K-0124)
(AD-A241158; AI-M-1293) Avail: NTIS HC/MF A03 CSCL 12/5

Computers and thought are the two categories that together define artificial intelligence as a discipline. It is generally accepted that work in artificial intelligence over the last thirty years has had a strong influence on aspects of computer architectures. In this paper, we also make the converse claim: that the state of computer architecture has been a strong influence on our models of thought. The Von Neumann model of computation has lead artificial intelligence in particular directions. Intelligence in biological systems is completely different. Recent work in behavior-based artificial intelligence has produced new models of intelligence that are much

closer in spirit to biological systems. The non-Von Neumann computational models they use share many characteristics with biological computation. GRA

N92-13719# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
LIMITATIONS OF NON MODEL-BASED RECOGNITION SCHEMES
Yael Moses and Shimon Ullman May 1991 23 p
(Contracts N00014-86-K-0685; DACA76-85-C-0010; N00014-86-K-0124; NSF IRI-89-00267)
(AD-A241162; AI-M-1301) Avail: NTIS HC/MF A03 CSCL 12/9

Different approaches to visual object recognition can be divided into two general classes: model-based vs. non model-based schemes. In this paper we establish some limitation on the class of non model-based recognition schemes. A non model-based scheme is based on functions invariant to viewing position and illumination conditions. We show that every function that is invariant to viewing position of all objects is the trivial (constant) function. The same result holds even if the recognition function is not required to be perfect, but is allowed to make mistakes and misidentify each object from a substantial fraction of viewing directions. It follows that every consistent recognition scheme for recognizing three dimensional objects must in general be model based. We then consider recognition schemes restricted to classes of objects and show that, for some classes, the only consistent recognition function is still the trivial function. For other classes (such as the class of symmetric objects) a nontrivial recognition scheme exists. We define the notion of a discrimination power of a consistent recognition function for a class of objects. The function's discrimination power determines the set of objects that can be discriminated by the recognition function. We show that it is possible to determine the upper bound of the function's discrimination power for every consistent recognition function. GRA

N92-13720# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
EXTRACTING AND REPRESENTING QUALITATIVE BEHAVIORS OF COMPLEX SYSTEMS IN PHASE SPACES
Feng Zhao Mar. 1991 23 p
(Contract N00014-89-J-3202; NSF MIP-90-01651)
(AD-A241163; AI-M-1274) Avail: NTIS HC/MF A03 CSCL 12/9

We develop a qualitative method for understanding and representing phase space structures of complex systems. To demonstrate this method, a program has been constructed that understands qualitatively different regions of the phase spaces and represents and extracts geometric shape information about these regions, using deep domain knowledge of dynamical system theory. Given a dynamical system specified as a system of governing equations, the program applies a successive sequence of operations to incrementally extract the qualitative information and generates a complete, high level symbolic description of the phase space structure, through a combination of numerical, combinatorial, and geometric computations and spatial reasoning techniques. The high level description is sensible to human beings and manipulable by other programs. We are currently applying the method to a difficult engineering design domain in which controllers for complex systems are to be automatically synthesized to achieve desired properties, based on the knowledge of the shapes of the systems. GRA

N92-13721# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
NONLINEAR ANALOG NETWORKS FOR IMAGE SMOOTHING AND SEGMENTATION
John Wyatt, A. Lumsdaine, and I. M. Elfadel Jan. 1991 48 p
(Contract N00014-85-K-0124; NSF MIP-88-14612)
(AD-A241164; AI-M-1280) Avail: NTIS HC/MF A03 CSCL 12/9

Image smoothing and segmentation algorithms are frequently formulated as optimization problems. Linear and nonlinear (reciprocal) resistive networks have solutions characterized by an extremum principle. Thus, appropriately designed networks can automatically solve certain smoothing and segmentation problems in robot vision. This paper considers switched linear resistive networks and nonlinear resistive networks for such tasks. The latter network type is derived from the former via an intermediate stochastic formulation, and a new result relating the solution sets of the two is given for the zero temperature limit. We then present simulation studies of several continuation methods that can be gracefully implemented in analog Very Large Scale Integration (VLSI) and that seem to give good results for these non-convex optimization problems. GRA

N92-13722# Naval Research Lab., Washington, DC.
ARTIFICIAL INTELLIGENCE TECHNICAL PAPER ABSTRACTS 1990
Cathy J. Wiley 5 Oct. 1991 26 p
(AD-A241403; NRL-MR-6897) Avail: NTIS HC/MF A03 CSCL 12/9

Artificial Intelligence Technical Paper Abstracts 1990 documents the accomplishment of projects at the Navy Center for Applied Research in Artificial Intelligence (NCARAI) in machine learning, natural language understanding, intelligent decision aids, and intelligent systems for robotic sensing and control. Points of contact are indicated for acquiring additional technical information about the projects, and an order form is provided for obtaining copies of the publications abstracted. This publication will be updated annually. GRA

N92-13723# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
CONFERENCE ON VISUAL INFORMATION ASSIMILATION IN MAN AND MACHINE Final Report, 1 Jun. - 30 Nov. 1990
Ramesh Jain 30 Nov. 1990 7 p
(Grant AF-AFOSR-0280-90; AF Proj. 2304)
(AD-A241462; AFOSR-91-0791TR) Avail: NTIS HC/MF A02 CSCL 23/2

The Artificial Intelligence Laboratory of the University of Michigan, in cooperation with the Cognitive Science and Machine Intelligence Laboratory, organized a conference on visual information assimilation. The primary funding agency for the conference was the Air Force Office of Scientific Research. The conference was successful in bringing together a diverse group of participants. About 100 people attended the conference, with cross-disciplinary attendees from both within the University of Michigan and outside. GRA

N92-13724# General Electric Co., Schenectady, NY.
REASONING WITH INCOMPLETE AND UNCERTAIN INFORMATION Final Report, May 1987 - Aug. 1990
Piero P. Bonissone, Jonathan P. Stillman, James K. Aragone, and Nancy C. Wood Aug. 1991 188 p
(Contract F30602-85-C-0033)
(AD-A241685; RL-TR-91-190) Avail: NTIS HC/MF A09 CSCL 12/5

This report summarizes research efforts in the area of Reasoning with Incomplete and Uncertain Information. The progress reported in this paper is mainly in three areas. The first is in applying RUM (Reasoning With Uncertainty Module) to different applications. The second is in developing the semantics of nonmonotonic reasoning. The third is in developing methods for combining nonmonotonic reasoning with uncertainty. This report consists of ten chapters, which have been, in part or full, previously published as papers in technical meetings or professional journals. These papers describe the theoretical advances that culminated with the development and application of PRIMO (Plausible Reasoning Module), a software tool implemented in Common Lisp and Flavors at GE. PRIMO is a reasoning system that integrates the theories of plausible and defaults reasoning. It consists of a language for representing uncertain and default knowledge, along with algorithms for reasoning in this language. PRIMO handles uncertain information by qualifying each possible value assignment

to any given variable with an uncertainty interval. PRIMO handles incomplete informaion by evaluation nonmonotonic justified (NMJ) rules. GRA

N92-13725# Pennsylvania State Univ., University Park. Dept. of Computer Science.
A COMPLEXITY THEORY OF NEURAL NETWORKS Final Technical Report, 15 Sep. - 14 Apr. 1991
Piotr Berman, Georg Schnitger, and Ian Parberry 9 Aug. 1991 14 p
(Grant AF-AFOSR-0400-87)
(AD-A241807; AFOSR-91-0881TR) Avail: NTIS HC/MF A03 CSCL 05/8

Significant progress has been made in laying the foundations of a complexity theory of neural networks. The fundamental complexity classes have been identified and studied. The class of problems solvable by small, shallow neural networks has been found to be the same class even if (1) probabilistic behavior (2) multi-valued logic, and (3) analog behavior, are allowed (subject to certain resonable technical assumptions). Neural networks can be made provably fault-tolerant by physically separating the summation units from the thresholding units. New results have also been obtained on the complexity of approximation, communication complexity, the complexity of learning from examples and counterexamples, learning with multi-valued neurons, exponential lower bounds for restricted neural networks, and fault tolerance in distributed computation. GRA

N92-13726# Sandia National Labs., Albuquerque, NM.
EFFECTIVE PATH PLANNING THROUGH TASK RESTRICTION
P. C. Chen 10 Sep. 1991 21 p Presented at the IEEE Conference on Robotics and Automation, Nice, France, 10 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-019066; SAND-91-1964C; CONF-9105260-1) Avail: NTIS HC/MF A03

We present a simple and effective path planning algorithm, an essential component in facilitating robot programming, based on a series of plausible task restriction. It is designed to solve realistic problems very quickly, at the expense of not being able to solve every problem. First, the notion of realistic problems is motivated with heuristic arguments and formalized through task restrictions. Next, an algorithm solving the resulting tasks of interest is provided. We prove its corrections and theoretical efficiency, and demonstrate empirically its effectiveness and speed. We expect our algorithm to be of practical significance based on its simplicity and predicted performance. DOE

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-13727# Florida Univ., Gainesville.
THE RELATIONSHIP BETWEEN FRACTAL GEOMETRY AND FRACTOGRAPHY
J. J. Mecholsky, Jr. and S. W. Freiman 28 Aug. 1991 12 p
(Contract N00014-90-J-1726)
(AD-A240835) Avail: NTIS HC/MF A03 CSCL 12/1

Fractal geometry has been used to describe irregular fracture surfaces in a quantitative way. The fractal dimensional increment has been related to the fracture toughness of the material through the elastic modulus and a characteristic structure parameter, ao. The study of fractography has shown the relationship between the flaw to mirror size ratio and the fracture toughness. An experimental observation has shown that the fracture toughness is related to the elastic modulus through another structure parameter, bo. Combining all of these relationships leads to the conclusion that the fractal dimensional increment, D*, is directly related to the flaw-to-mirror size ratio. This note shows that experimental measurements of the fractal dimension and the flaw-to-mirror size ratio on glasses, a glass ceramic, polycrystalline ceramics and a single crystal all agree with the prediction. The implication of this finding is that there is a linear scaling law in operation at fracture between the energy of crack initiation and branching and is reflected in the features on the fracture surface. GRA

N92-13728# Naval Postgraduate School, Monterey, CA.
APPROXIMATE INTERVAL ESTIMATION METHODS FOR THE RELIABILITY OF SYSTEMS USING DISCRETE COMPONENT DATA M.S. Thesis
Edmundo F. Bellini Sep. 1990 83 p
(AD-A241375) Avail: NTIS HC/MF A05 CSCL 12/3

Three lower confidence interval estimation procedures for system reliability of coherent systems with cyclic components are developed and their accuracy evaluated by Monte Carlo methods. Each method uses estimates of the ratios of component unreliabilities and the Poisson approximation to the binomial distribution to obtain the equation for the lower confidence limit. This is an extension of a method previously reported in the literature which has been shown to be fairly robust. The procedures developed here can be combined with similar procedures already developed for systems with continuous components. The combined procedure may yield a reasonably accurate lower confidence interval procedure for the reliability of coherent systems with mixtures of continuous and cyclic components. GRA

N92-13729# Naval Surface Warfare Center, Dahlgren, VA.
PUSHOUTS AND GRAPH RECONSTRUCTION Final Report
A. D. Parks Jun. 1991 14 p
(AD-A241410; NAVSWC-TR-91-325) Avail: NTIS HC/MF A03 CSCL 12/1

Reconstructibility of a graph G is shown to depend on the existence of morphisms that make each hypomorph of G a pushout of some card diagram G(sub v) approaches limit of N approaches limit of K, N a null graph and K a star graph. These morphisms i: N approaches limit of G(sub v) and j:N approaches limit of K are shown to exist for each hypomorph of G when there are isomorphisms psi, phi such that for some card G(sub v), phi x i= i' x psi, i' a hypomorphically induced monomorphism. This result relates reconstructibility to certain symmetry properties of cards and subsumes the good neighbor theorems. GRA

N92-13730# Naval Surface Warfare Center, Dahlgren, VA.
INTERVAL GRAPHS AND HYPERGRAPH ACYCLICITY DEGREE Final Report
A. D. Parks Jun. 1991 12 p
(AD-A241458; NAVSWC-TR-91-321) Avail: NTIS HC/MF A03 CSCL 12/1

In recent years much research has been devoted to the study of hypergraphs and their utility as relational database scheme models. It has been shown that such schemes enjoy certain desirable properties (e.g., monotone join expressions); that there is a linear ordering of the strengths (none of the reverse implications hold); and that strengthening the degree of acyclicity also strengthens the related desirable properties. Furthermore, it is known that a reduced hypergraph is alpha-acyclic if, and only if, it is conformal and its associated graph is chordal. The purpose of this report is to show that a reduced conformal hypergraph is beta-acyclic if its associated graph is an interval graph. As suggested by the previous theorem, if a collection of data has attributes with a natural interval graph representation, then it is possible to organize these data into a beta acyclic relational scheme (e.g., tracking data collected over time intervals. This may be an expedient design if resource allocation and deconfliction are important (conflicting attributes are in the same relation); frequent join operations are required and/or the databases are distributed. GRA

N92-13731# Educational Testing Service, Princeton, NJ.
BOOLEAN ALGEBRA APPLIED TO DETERMINATION OF UNIVERSAL SET OF KNOWLEDGE STATES
Kikumi K. Tatsuoka Aug. 1991 44 p

(Contract N00014-90-J-1307; Proj. RR04204)
(AD-A241548; ETS-RR-91-44-ONR) Avail: NTIS HC/MF A03 CSCL 12/2

Diagnosing cognitive errors possessed by examinees can be considered as a pattern classification problem which is designed to classify a sequential input of stimuli into one of several predetermined groups. The sequential inputs in our context are item responses and the predetermined groups are various states of knowledge resulting from misconceptions or different degrees of incomplete knowledge in a domain. In this study, the foundations of a combinatorial algorithm that will provide the universal set of states of knowledge will be introduced. Each state of knowledge is represented by a list of can/cannot cognitive tasks and processes (called cognitively relevant attributes or latent variables) which are usually unobservable. A Boolean descriptive function will be introduced as a mapping between the attribute space spanned by latent attribute variables and the item response space spanned by item score variables. The Boolean descriptive function plays the role of uncovering the unobservable content of a black box. Once all the possible classes are retrieved explicitly and expressed by a set of ideal item response patterns which are described by a can/cannot list of latent attributes, the notion of bug distributions and statistical pattern classification techniques will enable us to diagnose students' states of knowledge accurately. GRA

N92-13732# Naval Surface Warfare Center, Dahlgren, VA.
HOMOLOGY AND HYPERGRAPH ACYCLICITY: A COMBINATORIAL INVARIANT FOR HYPERGRAPHS Final Report
A. D. Parks and S. L. Lipscomb Jun. 1991 16 p
(AD-A241584; NAVSWC-TR-91-323) Avail: NTIS HC/MF A03 CSCL 12/2

The natural associations from finite hypergraphs and simple graphs to finite simplicial complexes are used to produce new hypergraph and graph invariants. This correspondence shows that alpha-acyclic hypergraphs and chordal graphs map to homologically acyclic complexes. A new degree of hypergraph acyclicity (h-acyclicity where the h keys homology) is introduced. It is shown that alpha-acyclic yields h-acyclic, and an example is given to show that this implication is not reversible. Application of these results to database design is discussed and a conjecture characterizing h-acyclic database schemes is stated. GRA

N92-13733# Naval Ocean Systems Center, San Diego, CA.
EIGENVALUES OF COVARIANCE MATRIX FOR TWO-SOURCE ARRAY PROCESSING Final Report, Oct. 1989 - Sep. 1990
S. I. Chou Nov. 1990 113 p
(AD-A241619; NOSC-TR-1370) Avail: NTIS HC/MF A06 CSCL 17/7

This report begins with a survey of narrowband direction-finding algorithms in element space. Then it discusses a simple stress measure to direction-finding algorithms applied to scenarios with two sources. Eigenvalue weighting appears in some noise subspace methods, in parametric signal subspace fitting methods, and in nonparametric subspace adaptive nulling beamforming. For a two-source array-processing scenario, normalized large and small eigenvalues are reduced to forms depending only on a real triplet. Presented also are some easy-to-remember formulas that enable one to exercise back-of-envelope assessment of scenarios. The small eigenvalue is shown to diminish qualitatively and quantitatively for two arrival scenarios increasingly stressed with high temporal and/or spatial correlations. The special case of equal-strength signal arrivals also important in low angle radar tracking, shares many rich structures. The equal-strength case also has several additional unique features for signal eigenvalue ratio which is important in direction finding. GRA

N92-13734# International Centre for Theoretical Physics, Trieste (Italy).
ON IMBEDDING THEOREMS IN CONNECTION WITH FREUD'S WEIGHT
Xuan Ky Nguyen and Quang Hoa Nguyen Dec. 1990 6 p
(DE91-633957; IC-90/403) Avail: NTIS HC/MF A02

This paper is a continuation of a work concerning Ul'janov-type imbedding theorems with best approximation and modulus of continuity in the case of Freud's weight. DOE

N92-13735# International Centre for Theoretical Physics, Trieste (Italy).
UNIFORM ULTIMATE BOUNDEDNESS RESULTS FOR SOME THIRD ORDER NONLINEAR DIFFERENTIAL EQUATIONS
A. U. Afuwape Nov. 1990 14 p
(DE91-633958; IC-90/405) Avail: NTIS HC/MF A03

A Liapunov function is used to prove the uniform ultimate boundedness of some third order nonlinear differential equations. DOE

N92-13736# International Centre for Theoretical Physics, Trieste (Italy).
THE CURVATURE AND THE ALGEBRA OF KILLING VECTORS IN FIVE-DIMENSIONAL SPACE
G. Rcheulishvili Dec. 1990 11 p
(DE91-633961; IC-90/416) Avail: NTIS HC/MF A03

This paper presents the Killing vectors for a five-dimensional space with the line element. The algebras which are formed by these vectors are written down. The curvature two-forms are described. DOE

N92-13737# International Centre for Theoretical Physics, Trieste (Italy).
PERIODIC SOLUTIONS OF CERTAIN THIRD ORDER NONLINEAR DIFFERENTIAL SYSTEMS WITH DELAY
H. O. Tejumola (Lincoln Univ., PA.) and A. U. Afuwape Dec. 1990 24 p
(DE91-633962; IC-90/418) Avail: NTIS HC/MF A03

This paper investigates the existence of 2(pi)-periodic solutions of systems of third-order nonlinear differential equations, with delay, under varied assumptions. The results obtained extend earlier works of Tejumola and generalize to third order systems those of Conti, Iannacci and Nkashama as well as DePascale and Iannacci and Iannacci and Nkashama. DOE

N92-13738# International Centre for Theoretical Physics, Trieste (Italy).
A NEW HEAT EQUATION PROOF OF MORSE INEQUALITIES
Y. Yanlin Dec. 1990 7 p
(DE91-633965; IC-90/437) Avail: NTIS HC/MF A02

This paper will give a new proof of the Morse inequalities by using the heat equation method without probability discussions. DOE

N92-13739# International Centre for Theoretical Physics, Trieste (Italy).
ITERATIVE SOLUTION FOR NONLINEAR INTEGRAL EQUATIONS OF HAMMERSTEIN TYPE
C. E. Chidume and M. O. Osilike (Nigeria Univ., Nsukka.) Dec. 1990 11 p
(DE91-633967; IC-90/445) Avail: NTIS HC/MF A03

Let E be a real Banach space with a uniformly convex dual, E(asterisk). Suppose N is a nonlinear set-valued accretive map of E into itself with open domain D; K is a linear single-valued accretive map with domain D(K) in E such that Im(N) is contained in D(K); K(exp -1) exists and satisfies less than K(exp -1)x-K(exp -1)y,j(x-y) greater than (ge)(beta) x-y (exp 2) for each x, y is an element of Im(K) and some constant (beta) greater than 0, where j denotes the single-valued normalized duality map on E. Suppose also that for each h is an element Im(K) the equation h is an element x+KNx has a solution x (asterisk) in D. An iteration method is constructed which converges strongly to x (asterisk). Explicit error estimates are also computed. DOE

N92-13740# International Centre for Theoretical Physics, Trieste (Italy).
ON LIPSCHITZIAN QUANTUM STOCHASTIC DIFFERENTIAL INCLUSIONS
G. O. S. Ekhaguere Dec. 1990 28 p
(DE91-633968; IC-90/452) Avail: NTIS HC/MF A03

Quantum stochastic differential inclusions are introduced and studied within the framework of the Hudson-Parthasarathy formulation of quantum stochastic calculus. Results concerning the existence of solutions of a Lipschitzian quantum stochastic differential inclusion and the relationship between the solutions of such an inclusion and those of its convexification are presented. These generalize the Filippov existence theorem and the Filippov-Wazewski Relaxation Theorem for classical differential inclusions to the present noncommutative setting. DOE

N92-13741# International Centre for Theoretical Physics, Trieste (Italy).
WEIGHTED NORM INEQUALITIES OF OPIAL AND HARDY TYPE FOR HIGHER-ORDER DERIVATIVES
C. O. Imoru Dec. 1990 9 p
(DE91-633970; IC-90/461) Avail: NTIS HC/MF A02

The object of this paper is to establish some new weighted integral inequalities of Opial and Hardy type which can be used in the analysis of solutions of ordinary differential equations and in the study of the bounds and compactness of the integral operators of Riemann-Liouville and Weyl. DOE

N92-13742# International Centre for Theoretical Physics, Trieste (Italy).
DECOMPOSITION NUMBERS OF CERTAIN LINEAR GROUPS
M. R. Darafsheh Dec. 1990 25 p
(DE91-633971; IC-90/465) Avail: NTIS HC/MF A03

The decomposition numbers of the linear groups GL(sub 5)(2) and GL(sub 6)(2) for all odd primes P dividing the order of the group under consideration are determined. DOE

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-13743*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
PROJECTION METHODS FOR THE NUMERICAL SOLUTION OF MARKOV CHAIN MODELS
Youcef Saad Oct. 1989 17 p
(Contract NCC2-387)
(NASA-CR-188905; NAS 1.26:188905; RIACS-TR-89-40) Avail: NTIS HC/MF A03 CSCL 12A

Projection methods for computing stationary probability distributions for Markov chain models are presented. A general projection method is a method which seeks an approximation from a subspace of small dimension to the original problem. Thus, the original matrix problem of size N is approximated by one of dimension m, typically much smaller than N. A particularly successful class of methods based on this principle is that of Krylov subspace methods which utilize subspaces of the form span(v,av,...,A(exp m-1)v). These methods are effective in solving linear systems and eigenvalue problems (Lanczos, Arnoldi,...) as well as nonlinear equations. They can be combined with more traditional iterative methods such as successive overrelaxation, symmetric successive overrelaxation, or with incomplete factorization methods to enhance convergence. Author

N92-13744*# Yale Univ., New Haven, CT. Dept. of Computer Science.
MARKOV REWARD PROCESSES Final Report
R. M. Smith 23 Oct. 1991 13 p
(Grant NAG1-897)
(NASA-CR-189489; NAS 1.26:189489) Avail: NTIS HC/MF A03 CSCL 12A

Numerous applications in the area of computer system analysis can be effectively studied with Markov reward models. These models describe the behavior of the system with a continuous-time Markov chain, where a reward rate is associated with each state. In a reliability/availability model, upstates may have reward rate 1 and down states may have reward rate zero associated with them. In a queueing model, the number of jobs of certain type in a given state may be the reward rate attached to that state. In a combined model of performance and reliability, the reward rate of a state may be the computational capacity, or a related performance measure. Expected steady-state reward rate and expected instantaneous reward rate are clearly useful measures of the Markov reward model. More generally, the distribution of accumulated reward or time-averaged reward over a finite time interval may be determined from the solution of the Markov reward model. This information is of great practical significance in situations where the workload can be well characterized (deterministically, or by continuous functions e.g., distributions). The design process in the development of a computer system is an expensive and long term endeavor. For aerospace applications the reliability of the computer system is essential, as is the ability to complete critical workloads in a well defined real time interval. Consequently, effective modeling of such systems must take into account both performance and reliability. This fact motivates our use of Markov reward models to aid in the development and evaluation of fault tolerant computer systems. Author

N92-13745# Texas A&M Univ., College Station. Dept. of Statistics.
NONPARAMETRIC ESTIMATION OF FUNCTIONS BASED UPON CORRELATED OBSERVATIONS Final Report, 1 Oct. 1985 - 31 Aug. 1991
Jeffrey D. Hart and Thomas E. Wehrly 10 Sep. 1991 8 p
(AD-A240830) Avail: NTIS HC/MF A02 CSCL 12/3

Our research efforts can be broken down into three categories: (1) smoothing dependent data, (2) general issues arising in function estimation, and (3) hypothesis testing based on smoothing methods. GRA

N92-13746# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Electrical and Computer Engineering.
BEHAVIOR-BASED FAULT MONITORING
John P. Shen 3 Dec. 1990 4 p
(Contract N00014-86-K-0507)
(AD-A241254) Avail: NTIS HC/MF A01 CSCL 12/6

An approach is developed which exploits the deterministic behavior of a processor to perform concurrent fault monitoring. A very low cost and highly effective technique, called Continuous Signature Monitoring (CSM), has been developed. This technique is capable of detecting transients with very low detection latency, and requires very minimal memory overhead and performance penalty. This technique has been applied to both CISC and RISC type processors. Both analytical and experimental results have been obtained in validating the effectiveness of the approach. CSM has been adopted by two aerospace companies in their design of a 32-bit RISC processor targeted for avionics and space applications. It appears that the signature monitoring technique can be extended to detect computer viruses as well via a form of program encryption. GRA

N92-13747# Washington Univ., Seattle. Dept. of Statistics.
ESTIMATION IN THE MIXTURE TRANSITION DISTRIBUTION MODEL FOR HIGH ORDER MARKOV CHAINS
Simon Tavare (University of Southern California, Los Angeles.) and Adrian E. Raftery Jun. 1991 26 p
(Contract N00014-88-K-0265; NSF DMS-88-03284; NSF DMS-90-05833)
(AD-A241341; TR-211) Avail: NTIS HC/MF A03 CSCL 12/3

The mixture transition distribution (MTD) model was introduced by Raftery (1985) as a parsimonious model for high-order Markov chains. It is flexible, can represent a wide range of dependence patterns, can be physically motivated, fits data well, and appears to be a discrete-valued analogue for the class of autoregressive time series models. However, estimation has presented difficulties because the parameter space is highly nonconvex, being defined by a large number of nonlinear constraints. Here we propose an efficient computational algorithm for maximum likelihood estimation which is based on a way of reducing the large number of constraints. This also allows more structured versions of the model,

for example those involving structural zeros, to be fit quite easily. A way of fitting the model using GLIM is also discussed. The algorithm is applied to a sequence of wind directions, and also to two sequences of DNA bases from introns from genes of the mouse. In each case, the MTD model fits better than the conventional Markov chain model. GRA

N92-13748# Washington Univ., Seattle. Dept. of Statistics.
THREE SHORT PAPERS ON SAMPLING-BASED INFERENCE: 1: HOW MANY ITERATIONS IN THE GIBBS SAMPLER? 2: MODEL DETERMINATION. 3: SPATIAL STATISTICS
Adrian E. Raftery, Steven Lewis, and Jeffrey D. Banfield Jun. 1991 43 p
(Contract N00014-88-K-0265)
(AD-A241409; TR-212) Avail: NTIS HC/MF A03 CSCL 12/3

This technical report consists of three short papers on Monte Carlo Markov chain inference. The first paper, How many iterations in the Gibbs sampler?, proposes an easily implemented method for determining the total number of iterations required to estimate probabilities and quantiles of the posterior distribution, and also the number of initial iterations that should be discarded to allow for burn-in. The second paper discusses model determination via predictive distributions. The paper advocates the standard Bayesian procedure that uses Bayes factors, and points out that this can be implemented quite easily using sampling-based methods. The third paper discusses issues in spatial statistics that use sampling-based methods. Several issues in the Bayesian image restoration approach are discussed: the modeling of spatial dependence, allowing for model uncertainty, the improper posterior distributions that arise in hierarchical Bayes modeling, and the modeling of local dependence between counts when it cannot be assumed that the observations are independent given the true rates. GRA

N92-13749# Naval Ocean Systems Center, San Diego, CA.
CONDITIONAL INFERENCE AND LOGIC FOR INTELLIGENT SYSTEMS: A THEORY OF MEASURE-FREE CONDITIONING
I. R. Goodman, Hung T. Nguyen, and Elbert A. Walker Aug. 1991 297 p Prepared in cooperation with New Mexico State Univ., Las Cruces
(AD-A241568) Avail: NTIS HC/MF A13 CSCL 12/3

This work addresses an anomaly involving probability and logic relative to the interpretation of implicative statements, and the evaluation of those statements compatible with conditional probability. One of our chief motivations is the need to formalize rigorously the connections between conditional probability and the hidden logic of implicative statements, such as production rules in expert systems and defaults in common-sense reasoning. The purpose is to provide theoretical results for probabilistic reasoning that will be useful in the design and evaluation of inference rules of such systems. GRA

N92-13750# Los Alamos National Lab., NM.
DIAGNOSIS OF NONLINEAR SYSTEMS USING TIME SERIES ANALYSIS
N. F. Hunter, Jr. 1991 23 p Presented at the 3rd International Machinery Monitoring and Diagnostic Conference, Las Vegas, NV, 9-12 Dec. 1991
(Contract W-7405-eng-36)
(DE91-016041; LA-UR-91-2283; CONF-911241-2) Avail: NTIS HC/MF A03

Diagnosis and analysis techniques for linear systems have been developed and refined to a high degree of precision. In contrast, techniques for the analysis of data from nonlinear systems are in the early stages of development. This paper describes a time series technique for the analysis of data from nonlinear systems. The input and response time series resulting from excitation of the nonlinear system are embedded in a state space. The form of the embedding is optimized using local canonical variate analysis and singular value decomposition techniques. From the state space model, future system responses are estimated. The expected degree of predictability of the system is investigated using the state transition matrix. The degree of nonlinearity present is quantified using the geometry of the transfer function poles in the z plane. Examples of application to a linear single-degree-of-freedom system, a single-degree-of-freedom Duffing Oscillator, and linear and nonlinear three degree of freedom oscillators are presented. DOE

N92-13751# International Centre for Theoretical Physics, Trieste (Italy).
AN ATTEMPT AT SOLVING THE PROBLEM OF AUTOCORRELATION ASSOCIATED WITH USE OF MEAN APPROACH FOR POOLING CROSS-SECTION AND TIME SERIES IN REGRESSION MODELLING
N. N. N. N. Nuamah Dec. 1990 9 p
(DE91-633969; IC-90/456) Avail: NTIS HC/MF A02

The paradoxical nature of results of the mean approach in pooling cross-section and time series data has been identified to be caused by the presence in the normal equations of phenomena such as autocovariances, multicollinear covariances, drift covariances and drift multicollinear covariances. This paper considers the problem of autocorrelation and suggests ways of solving it. DOE

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-13752# Naval Postgraduate School, Monterey, CA.
TOWARD A NATIONAL SPACE WARFIGHTING ARCHITECTURE: FORGING A FRAMEWORK FOR DEBATE ABOUT SPACE-BASED OPERATIONAL AND TACTICAL COMBAT SUPPORT M.S. Thesis
Robert O. Work Sep. 1990 196 p
(AD-A241075) Avail: NTIS HC/MF A09 CSCL 15/6

The primary objective of this thesis is to propose a template for a National Space Warfighting Architecture (NSWA). The template is intended to fill the void that exists between national security space policies and the services' space warfighting plans. As such, it will provide a unifying framework for follow-on discussions and debate about the proper direction of space-based operational and tactical combat support. In support of this objective, this thesis aims to: provide the proper focus for the architecture; identify the key conceptual ideas that should drive its development; establish a common vocabulary among managers of the Space-based Strategic Reconnaissance/Surveillance Program, service space support officers, and terrestrial warfighters; develop a logical and meaningful architectural organizational approach; facilitate the comparison between space-based and terrestrial-based combat support systems; and show how the NSWA fits within the larger framework of the National Space Program. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-13753# California Univ., Berkeley. Lawrence Berkeley Lab.
SINGLE RESONANCE THEORY WITH MAPS
E. Forest and J. Irwin (Stanford Linear Accelerator Center, CA.) Apr. 1990 10 p Presented at the Workshop on Non-Linear Problems in Future Particle Accelerators, Capri (Italy), 19-25 Apr. 1990
(Contracts DE-AC03-76SF-00098; DE-AC03-76SF-00515)
(DE90-013352; LBL-28931; CONF-9004230-1) Avail: NTIS HC/MF A02

We describe how one can perform a single resonance calculation using the single resonance map and the co-moving map. Again we emphasize that all the concepts of this paper have been implemented for the most complicated situations using

the Differential Algebra Package of Berz. In theory, it is possible and desirable to do similar calculations on fitted maps (a la Warnock) with fitted canonical transformations, unfortunately the tools based on fitted maps are not yet as versatile as DA-based tools. DOE

N92-13754# International Centre for Theoretical Physics, Trieste (Italy).
APPLICATION OF THE SUPERCONVERGENCE PROPERTIES OF THE GALERKIN APPROXIMATION TO RADIATIVE TRANSFER
M. S. AbdelKrim, M. T. Attia, and M. A. Madkour (Mansoura Univ., Egypt) Dec. 1990 16 p
(DE91-633959; IC-90/411) Avail: NTIS HC/MF A03

The Superconvergence Galerkin approximation is introduced to calculate some functionals arising in radiative transfer problems. Forward and backward radiation heat fluxes are calculated for comparison. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-13755# Brown Univ., Providence, RI. Dept. of Physics.
A RESEARCH PROGRAM IN COMPUTATIONAL PHYSICS Progress Report
G. S. Guralnik 1 Jul. 1990 9 p
(Contract DE-AC02-76ER-03130)
(DE90-013320; DOE/ER-03130/11) Avail: NTIS HC/MF A02

Task D's research is focused on the understanding of elementary particle physics through the techniques of quantum field theory. We make intensive use of computers to aid our research. During the last year we have made significant progress in understanding the weak interactions through the use of Monte Carlo methods as applied to the equations of quenched lattice QCD. We have launched a program to understand full (not quenched) lattice QCD on relatively large lattices using massively parallel computers. Because of our awareness that Monte Carlo methods might not be able to give a good solution to field theories with the computer power likely to be available to us for the forseeable future we have launched an entirely different numerical approach to study these problems. This Source Galerkin method is based on an algebraic approach to the field theoretic equations of motion and is (somewhat) related to variational and finite element techniques applied to a source rather than a coordinate space. The results for relatively simple problems are sensationally good. In particular, fermions can be treated in a way which allows them to retain their status as independent dynamical entities in the theory. DOE

N92-13756*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
BENCHMARK SOLUTIONS FOR THE GALACTIC HEAVY-ION TRANSPORT EQUATIONS WITH ENERGY AND SPATIAL COUPLING
Barry D. Ganapol, Lawrence W. Townsend, Stanley L. Lamkin (Old Dominion Univ., Norfolk, VA.), and John W. Wilson Washington Oct. 1991 58 p
(NASA-TP-3112; L-16909; NAS 1.60:3112) Avail: NTIS HC/MF A04 CSCL 20A

Nontrivial benchmark solutions are developed for the galactic heavy ion transport equations in the straightahead approximation with energy and spatial coupling. Analytical representations of the ion fluxes are obtained for a variety of sources with the assumption that the nuclear interaction parameters are energy independent. The method utilizes an analytical LaPlace transform inversion to yield a closed form representation that is computationally efficient. The flux profiles are then used to predict ion dose profiles, which are important for shield design studies. Author

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N92-13757*# Lockheed Aeronautical Systems Co., Burbank, CA.
DEVELOPMENT AND TESTING OF CABIN SIDEWALL ACOUSTIC RESONATORS FOR THE REDUCTION OF CABIN TONE LEVELS IN PROPFAN-POWERED AIRCRAFT Final Report, Oct. 1986 - Dec. 1990
H. L. Kuntz, R. J. Gatineau, R. A. Prydz, and F. J. Balena Washington NASA Oct. 1991 162 p
(Contract NAS1-18036)
(NASA-CR-4388; NAS 1.26:4388; LG90ER0119) Avail: NTIS HC/MF A08 CSCL 20A

The use of Helmholtz resonators to increase the sidewall transmission loss (TL) in aircraft cabin sidewalls is evaluated. Development, construction, and test of an aircraft cabin acoustic enclosure, built in support of the Propfan Test Assessment (PTA) program, is described. Laboratory and flight test results are discussed. Resonators (448) were located between the enclosure trim panels and the fuselage shell. In addition, 152 resonators were placed between the enclosure and aircraft floors. The 600 resonators were each tuned to a propfan fundamental blade passage frequency (235 Hz). After flight testing on the PTA aircraft, noise reduction (NR) tests were performed with the enclosure in the Kelly Johnson Research and Development Center Acoustics Laboratory. Broadband and tonal excitations were used in the laboratory. Tonal excitation simulated the propfan flight test excitation. The resonators increase the NR of the cabin walls around the resonance frequency of the resonator array. Increases in NR of up to 11 dB were measured. The effects of flanking, sidewall absorption, cabin absorption, resonator loading of trim panels, and panel vibrations are presented. Resonator and sidewall panel design and test are discussed. Author

N92-13758*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF AN ANNOYANCE MODEL BASED UPON ELEMENTARY AUDITORY SENSATIONS FOR STEADY-STATE AIRCRAFT INTERIOR NOISE CONTAINING TONAL COMPONENTS
James R. Angerer, David A. McCurdy, and Richard A. Erickson (Boeing Commercial Airplane Co., Seattle, WA.) Sep. 1991 85 p
(NASA-TM-104147; NAS 1.15:104147) Avail: NTIS HC/MF A05 CSCL 20A

The purpose of this investigation was to develop a noise annoyance model, superior to those already in use, for evaluating passenger response to sounds containing tonal components which may be heard within current and future commercial aircraft. The sound spectra investigated ranged from those being experienced by passengers on board turbofan powered aircraft now in service to those cabin noise spectra passengers may experience within advanced propeller-driven aircraft of the future. A total of 240 sounds were tested in this experiment. Sixty-six of these 240 sounds were steady state, while the other 174 varied temporally due to tonal beating. Here, the entire experiment is described, but the analysis is limited to those responses elicited by the 66 steady-state sounds. Author

N92-13759*# Sverdrup Technology, Inc., Brook Park, OH.
PREDICTION OF NOISE FIELD OF A PROPFAN AT ANGLE OF ATTACK Final Report
Edmane Envia Oct. 1991 22 p Presented at the Sixth International Symposium on Unsteady Aerodynamics, Aerocoustics, and Aeroelasticity of Turbomachines and Propellers, Notre Dame, IN, 15-19 Sep. 1991; sponsored by the International Union for Theoretical and Applied Mechanics
(Contract NAS3-25266)
(NASA-CR-189047; E-6645; NAS 1.26:189047) Avail: NTIS HC/MF A03 CSCL 20A

A method for predicting the noise field of a propfan operating

at an angle of attack to the oncoming flow is presented. The method takes advantage of the high-blade-count of the advanced propeller designs to provide an accurate and efficient formula for predicting their noise field. The formula, which is written in terms of the Airy function and its derivative, provides a very attractive alternative to the use of numerical integration. A preliminary comparison shows rather favorable agreement between the predictions from the present method and the experimental data.
Author

N92-13760# Texas Univ., Austin. Applied Research Lab.
EXPERIMENTAL DETECTION OF A SLOW ACOUSTIC WAVE IN SEDIMENT AT SHALLOW GRAZING ANGLES: BOTTOM PENETRATION AT SHALLOW GRAZING ANGLES Final Report, 2 Feb. 1990 - 31 Jan. 1991
Frank A. Boyle and Nicholas P. Chotiros 24 May 1991 50 p
(Contract N00039-88-C-0043)
(AD-A240870; ARL-TR-91-14) Avail: NTIS HC/MF A03 CSCL 20/4

Following recent experimental results at sea (N.P. Chotiros, Proceedings of Ocean 1989) that suggest the existence of a previously undetected type of acoustic wave in sandy sediments, an experiment was designed to detect and measure the speed of acoustic waves in an isolated environment. The experiment was conducted in a laboratory tank containing 1 m of unwashed river sediment under a 3 m water column. Observations were made of the travel time and attenuation of a pulse from an acoustic source located above the water-sediment interface to a set of probes below the interface. It was observed that at normal incidence the pulse traveled at about 1675 m/s, while at shallow grazing angles the pulse traveled through the sediment at close to 1200 m/s. An interesting possible explanation exists in the Biot theory for acoustic propagation through fluid-saturated porous media, which predicts a slow acoustic wave in porous materials. GRA

N92-13761# Texas Univ., Austin. Dept. of Mechanical Engineering.
PROBLEMS IN NONLINEAR ACOUSTICS: PULSED FINITE AMPLITUDE SOUND BEAMS, NONLINEAR PROPAGATION OF SOUND IN LAYERED MEDIA, TIME DOMAIN SOLUTIONS FOR FOCUSED SOUND BEAMS, FOCUSING OF SOUND WITH AN ELLIPSOIDAL MIRROR, AND MODELING FINITE AMPLITUDE PROPAGATION IN WAVEGUIDES Annual Report
Mark F. Hamilton 1 Aug. 1991 18 p
(Contract N00014-89-J-1003)
(AD-A240925) Avail: NTIS HC/MF A03 CSCL 20/1

Five projects are discussed in this annual summary report, all of which involve basic research in physical acoustics, mainly nonlinear acoustics. (1) Pulsed Finite Amplitude Sound Beams are investigated numerically with a time domain computer algorithm, and experiments are underway to study nonlinear self-demodulation. (2) Nonlinear Propagation of Sound in Layered Media involves studies of shallow water above a penetrable bottom (both theory and experiment) and the Sound Fixing and Ranging (SOFAR) channel (only theory). (3) Time Domain Solutions for Axial Pressures in Focused Sound Beams is a theoretical comparison of three different models. (4) Focusing of Sound with an Ellipsoidal Mirror is a theoretical study of the reflected field, typically short pulses, along the axis of the mirror. (5) Modeling Finite Amplitude, Propagation in Waveguides with a Nonlinear Parabolic Wave Equation is a new project that involves both theory and experiment. GRA

N92-13762# Texas Univ., Austin. Applied Research Lab.
NONLINEAR ACOUSTICS: PROPAGATION IN A PERIODIC WAVEGUIDE, SCATTERING OF SOUND BY SOUND, PROPAGATION THROUGH A THREE-LAYER FLUID, AND NONLINEARITY PARAMETERS OF SEA WATER Annual Summary Report No. 3, 1 Oct. 1990 - 30 Sep. 1991
David T. Blackstock 19 Aug. 1991 42 p
(Contract N00014-89-J-1109)
(AD-A241294; ARL-TR-91-21) Avail: NTIS HC/MF A03 CSCL 20/1

Research on nonlinear acoustics has been carried out during the 12-month period ending 30 September 1991. Progress on four primary projects (1-4): (1) Airborne acoustic Bloch waves in a periodic waveguide: Both theoretical and experimental work was done on effect of modifying the structure to double the periodicity length of the waveguide, propagation of narrowband Bloch wave pulses, and energy transport velocity and group velocity of Bloch waves. (2) Scattering of sound by sound: Propagation curves and beam patterns were measured to investigate finger radiation, which is a degenerate form of sound scattered by sound. The results confirmed some theoretical predictions but cast doubt on others. Classical crossed beam measurements were begun, but results so far are inconclusive. (3) Finite-amplitude waves in a three-layer fluid: A high precision positioning system was designed and built for experiments to be done in a water tank. Theoretical work was also started. (4) Properties of sea water and fresh water for finite-amplitude wave calculations: Pressure, temperature, and salinity sependence were obtained for the coefficient of nonlinearity beta and a related quantity salinity dependence were obtained for the coefficient of nonlinearity beta and a related quantity. Miscellaneous projects included ellipsoidal focusing of sound in air. GRA

N92-13857*# Polytechnic Univ., Brooklyn, NY. Dept. of Mathematics.
CRITICAL PROBLEMS OF COMPUTATIONAL AEROACOUSTICS
Joel C. W. Rogers *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 190-197 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20A

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-13763# Fermi National Accelerator Lab., Batavia, IL.
MEASUREMENT OF (-p)p ELASTIC SCATTERING PARAMETERS AT THE SQUARE ROOT OF s = 1.8 TeV
S. Shukla Aug. 1991 9 p Presented at the 4th International Conference on Elastic and Diffractive Scattering, Isola D'Elba (Italy), 22-25 May 1991
(Contract DE-AC02-76CH-03000)
(DE91-018960; FNAL/C-91/216; CONF-9105241-2) Avail: NTIS HC/MF A02

A measurement of the total nuclear cross section, sigma(sub t), the ratio of the real to the imaginary part of the forward nuclear elastic scattering amplitude, rho, and the nuclear slope parameter, B, for (-p)p elastic scattering at the square root of s equals 1.8 TeV, is presented. We find sigma(sub t) equals 72.8 +/- 3.1 mb, rho equals 0.140 +/- 0.69 and B equals 16.99 +/- .47 GeV/c(exp -2). DOE

N92-13764# Australian National Univ., Canberra. Research School of Physical Sciences.
TRANSIENT FIELD MEASUREMENTS OF g-FACTORS IN Pt(194, 196, 198); g(2 SUB 1, SUP +) SYSTEMATICS IN TRANSITIONAL W, Os, Pt NUCLEI
A. E. Stuchbery, G. J. Lampard, and H. H. Bolotin (Melbourne Univ., Parkville, Australia) Jan. 1991 33 p
(DE91-634730; ANU-P-1065) Avail: NTIS HC/MF A03

Transient field processions were measured simultaneously for levels in the nuclei W(182,184,186) and Pt(194,196,198) as their ions traversed polarized Gd hosts. These results allow a critical evaluation of conflicting g-factor values reported previously for the even Pt isotopes. Mass variations of g(2 sub 1, sup +) in the even W, Os, Pt nuclei are examined using the proton-neutron interacting boson model (IBM-2). The measured g-factors depart from the simplest IBM-2 description perhaps due to subshell effects

and/or small contributions from non-collective configurations which cause the neutron-boson g-factor to vary with mass. DOE

N92-13765*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INELASTIC AND REACTIVE SCATTERING OF HYPERTHERMAL ATOMIC OXYGEN FROM AMORPHOUS CARBON
Timothy K. Minton, Christine M. Nelson, David E. Brinza, and Ranty H. Liang 15 Aug. 1991 36 p
(Contract NAS7-918)
(NASA-CR-189031; JPL-Publ-91-34; NAS 1.26:189031) Avail: NTIS HC/MF A03 CSCL 20H

The reaction of hyperthermal oxygen atoms with an amorphous carbon-13 surface was studied using a modified universal crossed molecular beams apparatus. Time-of-flight distributions of inelastically scattered O-atoms and reactively scattered CO-13 and CO2-13 were measured with a rotatable mass spectrometer detector. Two inelastic scattering channels were observed, corresponding to a direct inelastic process in which the scattered O-atoms retain 20 to 30 percent of their initial kinetic energy and to a trapping desorption process whereby O-atoms emerge from the surface at thermal velocities. Reactive scattering data imply the formation of two kinds of CO products, slow products whose translational energies are determined by the surface temperature and hyperthermal (Approx. 3 eV) products with translational energies comprising roughly 30 percent of the total available energy (E sub avl), where E sub avl is the sum of the collision energy and the reaction exothermicity. Angular data show that the hyperthermal CO is scattered preferentially in the specular direction. CO2 product was also observed, but at much lower intensities than CO and with only thermal velocities. Author

N92-13766# Stanford Linear Accelerator Center, CA.
A SEARCH FOR THE PRODUCTION OF THE FINAL STATES TAU(+) TAU(-) e(+) e(-), TAU(+) TAU(-) MU(+) MU(-), AND TAU(+) TAU(-) PI(+) PI(-) IN e(+) e(-) COLLISIONS AT SQUARE ROOT OF S = 29 GeV
Jul. 1991 10 p Presented at the 15th Joint International Lepton Photon Symposium at High Energies and European Physical Society (EPS) Conference on High Energy, Geneva, Switzerland, 25 Jul. - 1 Aug. 1991 Prepared in cooperation with Lawrence Berkeley Lab., CA; Harvard Univ., Cambridge, MA
(Contract DE-AC03-76SF-00515)
(DE91-018884; SU-SLAC-PUB-5600; LBL-31178; CONF-9107172-1) Avail: NTIS HC/MF A02

We have searched for the reaction e(+) e(-) yields tau(+) tau(-) (bar f)f, where f is either an electron, muon, or charged pion, at square root of s equals 29 GeV using the Mark 2 detector at the Positron Electron Proton (PEP) storage ring. One candidate event is found while 2.3 events are expected from known processes. We would expect to see 11 events if the cross-section for e(+) e(-) yields tau(+) tau(-) (bar f)f at (radical)s equals 29 GeV were enhanced by the factor of 4.7 which the ALEPH collaboration reports for square root of s equals 91 GeV. We also look for e(+) e(-) yields e(+) e(-) (bar)f f and e(+) e(-) yields mu(+) mu(-) (bar f)f, and for e(+) e(-) yields tau(+) tau(-) gamma using a similar analysis procedure and see the number of events predicted by the standard model. DOE

N92-13767# Fermi National Accelerator Lab., Batavia, IL.
RESULTS FROM (-p)p COLLIDERS
J. Huth Aug. 1991 30 p Presented at the Particles and Fields 1991, Vancouver (Canada), 18-22 Aug. 1991
(Contract DE-AC02-76CH-03000)
(DE92-000156; FNAL/C-91/223-E; CONF-910881-7) Avail: NTIS HC/MF A03

Recent results (-p)p colliders are presented. From elastic scattering experiments at the Tevatron, an average value of sigma (sub tot) = 72.1 +/- 2 mb is reported, along with a new measurement of rho = 0.13 +/- 0.7. New measurements of jet direct photon and high p(sub t) W and Z production are compared to more precise, higher order predictions from perturbative QCD. Recently available data on the W mass and width give combined values for M(sub W) = 80.14 +/- 0.27 GeV/c(exp 2), and gamma(W) = 2.14 +/- 0.08 GeV. From electroweak radiative corrections and M(sub W), one finds M(sub top) = 130 +/- 40 GeV/c(exp 2), with a 95 percent C.L. upper limit at 210 GeV/c(exp 2). Current limits on M(sub top) are presented, along with a review of the prospects for top discovery. From jet data there is no evidence of quark substructure down to the distance scale of 1.4 x 10(exp -17) cm, nor is there evidence for supersymmetry or heavy gauge bosons at (-p)p colliders, allowing lower limits on M(sub W), greater than 520 GeV/c(exp 2) and M(sub Z) 412 GeV/c(exp 2). DOE

N92-13768# Los Alamos National Lab., NM.
MUONIUM TO ANTIMUONIUM CONVERSION AND THE DECAY MU(+) YIELDS e(+) (-)NU(SUB e) NU(SUB MU) IN LEFT-RIGHT SYMMETRIC MODELS
P. Herczeg and R. N. Mohapatra (Maryland Univ., College Park.) 1991 4 p Presented at the Particles and Fields '91, Vancouver, Canada, 18-22 Aug. 1991
(Contract W-7405-eng-36)
(DE92-000195; LA-UR-91-3038; CONF-910881-10) Avail: NTIS HC/MF A01

We investigate muonium to antimuonium conversion and the exotic muon decay mu(+) yields e(+)(bar nu(sub e)nu(sub mu) in SU(2)(sub L) x SU(2)(sub R) x U(1)(sub B-L) models. DOE

N92-13769# Ballistic Research Labs., Aberdeen Proving Ground, MD.
MONTE CARLO CALCULATIONS OF THE PROPERTIES OF SOLID NITROMETHANE Final Report, Feb. - Jun. 1991
Betsy M. Rice and Samuel F. Trevino Sep. 1991 25 p
(AD-A241553; BRL-TR-3268) Avail: NTIS HC/MF A03 CSCL 19/1

Pairwise additive potential energy functions for H-O, H-H, and O-O intermolecular interactions are presented; methods by which these functions were developed are discussed, and preliminary Monte Carlo calculations of the crystal lattice parameters using these functions are presented. The results indicate that these potential energy functions correctly reproduce the lattice parameters measured by neutron diffraction at 4.2 K, ambient pressure, and at pressures below 1.0 GPa, room temperature. It is our intention in this and future work to obtain sufficient information concerning the intermolecular interactions between molecules of nitromethane (CH3NO2) in order to produce, via computer simulation, a reliable equation of state and other related properties in the condensed phase. For this purpose, substantial experimental investigations have been performed in the past on several properties of the crystal. For the present study, the most important of these are the determination of the crystal structure at ambient pressure, from 4.2 K to 228 K (Trevino, Prince, and Hubbard 1980) and neutron spectroscopic determination of the rotational properties of the methyl group (Trevino and Rymes 1980; Alefeld et al. 1982; Cavagnat et al. 1985). GRA

N92-13770# Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics and Theoretical Physics.
IONIZATION AND NEUTRALIZATION PROCESSES Final Report, 1 Apr. 1988 - 31 Mar. 1991
David R. Bates 24 May 1991 21 p
(Grant AF-AFOSR-0190-88; AF Proj. 2303)
(AD-A241636; PL-TR-91-2203) Avail: NTIS HC/MF A03 CSCL 20/5

A review on dissociative recombination between positive ions and negative ions of polycyclic aromatic hydrocarbons has been published. Accurate R-matrix calculations of dielectronic recombination of 0+ have been made. A new recombination process, tidal termolecular ionic recombination, has been discovered. Termolecular association between diatomic molecules has been discussed. Rate coefficients for excitation and charge transfer in N-O, N-O+, N+-0 collisions have been calculated. Transition probabilities have been computed for several bands of O2. The production of O(1S) from the dissociative recombination

of O2+, and the production of vibrationally excited O2+ in the nocturnal F-region, have been considered. Regarding the formation of heavy O3 and heavy CO2, a proof has been given that isotropic fractionation cannot be explained by symmetry considerations alone, and it has been argued that the enhancement of heavy O3 observed in the stratosphere is due to termolecular association. A review on negative ions has been written. GRA

N92-13771# Purdue Univ., West Lafayette, IN. Dept. of Chemistry.
RECONSTRUCTION AT ORDERED Au(110)-AQUEOUS INTERFACES AS PROBED BY ATOMIC-RESOLUTION SCANNING TUNNELING MICROSCOPY
X. Gao, A. Hamelin, and M. J. Weaver Oct. 1991 17 p
(Contract N00014-91-J-1409)
(AD-A241801; TR-110) Avail: NTIS HC/MF A03 CSCL 20/5

Atomic resolution scanning tunneling microscopy (STM) images of ordered Au(110) in aqueous 0.1 M HClO4, reported as a function of electrode potential, provide an unusually detailed picture of surface reconstruction. Lowering the potential of a freshly annealed surface to -0.3 V vs SCE yield images consisting primarily of domains having (1 x 2) symmetry. While the (1 x 2) structure exhibits an atomic density commensurate with the usual missing row model, the images suggest that significant relaxation of both top- and second-layer atoms occurs. Three-atom wide ribbons, lying along the (110) direction, are seen to provide the basic building blocks of the reconstruction; these units also yield added row domains of (1 x n) symmetry, where n=3 or higher. The reconstruction is lifted, yielding the (1x1) Au(110) surface, rapidly (within ca 2s) upon altering the potential to O V vs SCE, yet reappears immediately upon returning to -0.3 V. GRA

N92-13772# International Centre for Theoretical Physics, Trieste (Italy).
A 2-D PARTICLE IN UNIFORM CROSSED E, B FIELDS: CONTINUOUS SPECTRUM, DISCRETE OPTICAL TRANSITION RULES
F. Claro and S. Mendoza Dec. 1990 8 p
(DE91-633987; IC-90/442) Avail: NTIS HC/MF A02

A charged particle constrained to move in two dimensions in the presence of a perpendicular magnetic field has a discrete energy spectrum. Observed from a moving frame, however, the spectrum is continuous. We show that emission and absorption of photons differs in both frames by a Doppler shift only and that allowed frequencies are grouped in bands of width proportional to the Compton wavelength. DOE

N92-13773# International Centre for Theoretical Physics, Trieste (Italy).
SPONTANEOUS PARITY BREAKING IN 2+1 DIMENSIONAL QED WITH A FAMILY OF FOUR-FERMI INTERACTIONS
S. H. Park and Y. Shamir Nov. 1990 13 p
(DE91-634060; IC-90/417) Avail: NTIS HC/MF A03

We study the spontaneous breaking of parity in 2+1 dimensional QED with a family of four-Fermi interactions parameterized by two integers, N and O less than or = M less than or = N. In the context of the 1/N expansion, a parity violating fermion mass can be generated dynamically, and parity violation is characterized by theta = 1-2M/N. Calculating the vacuum energy densities to the next-to-leading order in 1/N, we show that the theory with minimal parity violation has the lowest ground state energy. The physical origin of this behavior is discussed. DOE

N92-13774# International Centre for Theoretical Physics, Trieste (Italy).
FIELD-INDUCED NARROWING OF AUTO-IONIZATION ATOMIC STATES AS A WAY OF CREATING INVERSE POPULATION
S. A. Kotochigova Oct. 1990 18 p
(DE91-634158; IC-90/362) Avail: NTIS HC/MF A03

We discuss the possibility of narrowing the atomic autoionization states via their resonance mixing in a field. The results show that, in contrast to the mixing of isolated states, with mixing of multiplets one may expect substantial narrowing of autoionization states owing to their intersection with bound electron states. DOE

N92-13775# International Centre for Theoretical Physics, Trieste (Italy).
THE EFFECT OF IMPURITIES ON THE SOLITON EXCITATIONS OF ONE-DIMENSIONAL FERROMAGNETIC CHAINS
Ninjia Zhu and Shu Cao Dec. 1990 7 p
(DE91-634184; IC-90/400) Avail: NTIS HC/MF A02

A soliton excitation theory in one-dimensional (1-D) ferromagnetic chain with impurities has been assessed using the V.I. Karpman's perturbation theory on the basis of the soliton theory in a pure 1-D ferromagnetic chain discussed by D. I. Pushkarov, and the favorable condition of the existence of the moving single solitons in the new ferromagnetic chain system has also been found. DOE

N92-13776# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
MONTE CARLO SIMULATION OF DIFFERENT VARIANTS OF THE EXPERIMENT ON OBSERVATION OF POLARIZATION VECTOR ROTATION OF SIGMA(+)-HYPERON BEAMS IN BENT CRYSTAL ON THE BASE OF E761 SET-UP (FNAL, US)
V. V. Baublis 1990 18 p In RUSSIAN; ENGLISH summary
(DE91-636438; LIYaF-1592) Avail: NTIS HC/MF A03

The results of Monte-Carlo simulation of different variants of the experiment on study of the effect of Sigma (sup +) hyperon spin precession in electric field of the bent silicon crystal on the base of set-up E761 are given. DOE

N92-13777# Los Alamos National Lab., NM.
A MEASUREMENT OF THE GRAVITATIONAL ACCELERATION OF THE ANTIPROTON
J. A. Schecker 1991 4 p Presented at the Particles and Fields 1991, Vancouver (Canada), 18-22 Aug. 1991
(Contract W-7405-eng-36)
(DE92-000368; LA-UR-91-2888; CONF-910881-12) Avail: NTIS HC/MF A01

An experiment is being developed which will compare the acceleration, g, of the antiproton in the earth's gravitational field with that of H(-) ions. This measurement will constitute the first direct test of the Weak Equivalence Principle (WEP) for antimatter. Low energy antiprotons from the LEAR facility at CERN will be decelerated, cooled and launched into a field free region, and the time of flight to a detector will determine g. The technical aspects of the experiment and our progress in the different areas are presented. DOE

N92-13778# Fermi National Accelerator Lab., Batavia, IL.
ISOLATED SINGLE AND DOUBLE DIRECT PHOTON PRODUCTION AT CDF
R. Harris Sep. 1991 5 p Presented at the Particles and Fields 1991, Vancouver (Canada), 18-22 Aug. 1991
(Contract DE-AC02-76CH-03000)
(DE92-000471; FNAL/C-91/236-E; CONF-910881-15) Avail: NTIS HC/MF A01

We present measurements of isolated direct photon production in (bar-p)p collisions at square root of s = 1.18 TeV from the 1988--89 run of the Collider Detection at Fermilab (CDF). Quantum Chromodynamics is tested against measurements of the transverse momentum spectrum of single photon production ((bar p)p yields gamma + X), double photon production ((bar p)p yields gamma(gamma) + X), and the distribution of cos(theta)(sup *) in photon-jet events ((bar p)p yields (gamma)J + X). We also present a measurement of the isolated production ratio of (eta) and pi(exp 0) mesons ((bar p)p yields eta + X)/((bar p)p yields pi(sup 0) + X) = 1.02 plus or minus .15(stat) plus or minus .23(sys). DOE

N92-13855*# Puerto Rico Univ., Mayaguez. Dept. of Electrical and Computer Engineering.
NATURALLY INDUCED SECONDARY RADIATION IN INTERPLANETARY SPACE: PRELIMINARY ANALYSES FOR GAMMA RADIATION AND RADIOISOTOPE PRODUCTION FROM THERMAL NEUTRON ACTIVATION
Heriberto Plaza-Rosado *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 181-185 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N92-13779# Oak Ridge National Lab., TN.
OPERATIONAL READINESS REVIEW PLAN FOR THE RADIOISOTOPE THERMOELECTRIC GENERATOR MATERIALS PRODUCTION TASKS
R. H. Cooper, M. M. Martin, C. R. Riggs, R. L. Beatty, E. K. Ohriner, and R. N. Escher 19 Apr. 1990 26 p
(Contract DE-AC05-84OR-21400)
(DE90-012026; ORNL/M-1137) Avail: NTIS HC/MF A03

In October 1989, a Space Shuttle lifted off from Cape Kennedy carrying the spacecraft Galileo on its mission to Jupiter. In November 1990, a second spacecraft, Ulysses, will be launched from Cape Kennedy with a mission to study the polar regions of the sun. The prime source of power for both spacecraft is a series of radioisotope thermoelectric generators (RTG's), which use plutonium oxide (plutonia) as a heat source. Several of the key components in this power system are required to ensure the safety of both the public and the environment and were manufactured at Oak Ridge National Laboratory (ORNL) in the 1980 to 1983 period. For these two missions, Martin Marietta Energy Systems, Inc. (Energy Systems), will provide an iridium-alloy component used to contain the plutonia heat source and a carbon-composite material that serves as a thermal insulator. ORNL alone will continue to fabricate the carbon-composite material. Because of the importance to DOE that Energy Systems deliver these high-quality components on time, performance of an Operational Readiness Review (ORR) of these manufacturing activities is necessary. Energy Systems Policy GP-24 describes the formal and comprehensive process by which appropriate energy systems' activities are to be reviewed to ensure their readiness. This energy system policy is aimed at reducing the risks associated with mission success and requires a management-approved readiness plan to be issued. This document is the readiness plan for the RTG materials production tasks. DOE

N92-13780# Naval Research Lab., Washington, DC.
FURTHER STUDIES ON BEAM BREAKUP GROWTH REDUCTION BY CAVITY CROSS-COUPLINGS IN RECIRCULATING ACCELERATORS: EFFECTS OF LONG PULSE LENGTH AND MULTITURN RECIRCULATION Interim Report
D. Colombant and Y. Y. Lau 26 Sep. 1991 37 p
(ARPA Order 7781)
(AD-A241402; NRL-MR-6875) Avail: NTIS HC/MF A03 CSCL 20/7

Cavity cross-coupling was recently found to reduce beam breakup (BBU) growth in a recirculating accelerator known as the Spiral LIne Induction Accelerator (SLIA). Here, we extend the analyses in two respects: long beam pulse lengths and a SLIA upgrade geometry which accelerates a 10 kA, 35 ns beam to 25 MeV via a 70-cavity, 7-turn recirculation. We found that when the beam pulse length tau exceeds the beam's transit time tau' between cross-coupled cavities, BBU growth may be worsened as a result of the cross-couplings among cavities. This situation is not unlike other long pulse recirculating accelerators when beam recirculation leads to beam breakup of a regenerative type. Thus, the advantage of BBU reduction by cavity cross-coupling is restricted primarily to beams with tau is less than tau', a condition envisioned for all SLIA geometries. For the 70-gap, 7-turn SLIA upgrade, we found that cavity cross-coupling may reduce BBU growth up to factors of a thousand when the quality factor Q of the deflecting modes are relatively high (like 100). In these high Q cases, the amount of growth reduction depends on the arrangement and sequence of beam recirculation. For Q less than or = 20, BBU growth reduction by factors of hundreds is observed, but this reduction is insensitive to the sequence of beam recirculation. The above conclusions were based on simple models of cavity coupling that have been used in conventional microwave literature. GRA

N92-13781*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TARGET CORRELATION EFFECTS ON NEUTRON-NUCLEUS TOTAL, ABSORPTION, AND ABRASION CROSS SECTIONS
Francis A. Cucinotta, Lawrence W. Townsend, and John W. Wilson Washington Dec. 1991 20 p
(NASA-TM-4314; L-16955; NAS 1.15:4314) Avail: NTIS HC/MF A03 CSCL 20H

Second order optical model solutions to the elastic scattering amplitude were used to evaluate total, absorption, and abrasion cross sections for neutron nucleus scattering. Improved agreement with experimental data for total and absorption cross sections is found when compared with first order (coherent approximation) solutions, especially below several hundred MeV. At higher energies, the first and second order solutions are similar. There are also large differences in abrasion cross section calculations; these differences indicate a crucial role for cluster knockout in the abrasion step. Author

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N92-13782*# Alabama Univ., Huntsville. Center for Applied Optics.
X RAY MICROSCOPE/TELESCOPE TEST AND ALIGNMENT Final Report, 26 Jun. 1990 - 25 Jun. 1991
Arthur B. C. Walker (Stanford Univ., CA.) and Richard B. Hoover Jul. 1991 49 p
(Contract NAS8-36955)
(NASA-CR-184258; NAS 1.26:184258) Avail: NTIS HC/MF A03 CSCL 20F

The tasks performed by the Center for Applied Optics (CAO) in support of the Normal Incidence Multilayer X-Ray Optics Program are detailed. The Multi-Spectral Solar Telescope Array (MSSTA) was launched on a Terrier-boosted Black Brant sounding rocket from White Sands Missile Range on 13 May 1991. High resolution images of the sun in the soft x ray to extreme ultraviolet (EUV) regime were obtained with normal-incidence Cassegrain, Ritchey-Chretien, and Herschelian telescopes mounted in the sounding rocket. MSSTA represents the first use of multilayer optics to study a very broad range of x ray and EUV solar emissions. Energy-selective properties of multilayer-coated optics allow distinct groups of emission lines to be isolated in the solar corona and transition region. Features of the near and far coronal structures including magnetic loops of plasmas, coronal plumes, coronal holes, faint structures, and cool prominences are visible in these images. MSSTA successfully obtained unprecedented information regarding the structure and dynamics of the solar atmosphere in the temperature range of 10(exp 4)-10(exp 7) K. The performance of the MSSTA has demonstrated a unique combination of ultra-high spatial resolution and spectral differentiation by use of multilayer optics. Author

N92-13783*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A NEW TECHNIQUE FOR OIL BACKSTREAMING CONTAMINATION MEASUREMENTS
S. A. Alterovitz, H. J. Speier, R. M. Sieg, M. N. Drotos, and J. E. Dunning (Michigan State Univ., East Lansing.) 1991 13 p Presented at the 38th Annual American Vacuum Society Symposium, Seattle, WA, 11-15 Nov. 1991
(NASA-TM-105312; E-6665; NAS 1.15:105312) Avail: NTIS HC/MF A03 CSCL 20F

Due to the large size and the number of diffusion pumps, space simulation chambers cannot be easily calibrated by the usual test dome method for measuring backstreaming from oil diffusion pumps. In addition, location dependent contamination may be an important parameter of the test. The backstreaming contamination was measured in the Space Power Facility (SPF) near Sandusky, OH, the largest space simulation vacuum test chamber in the U.S.. Small clean silicon wafers placed at all desired measurement sites were used as contamination sensors. The facility used diffusion pumps with DC 705 oil. The thickness of the contamination oil film was measured using ellipsometry. Since the oil did not wet the silicon substrate uniformly, two analysis models were developed to measure the oil film: (1) continuous, homogeneous film; and (2) islands of oil with the islands varying in coverage fraction and height. In both cases, the contamination film refractive index was assumed to be that of DC 705. The second model improved the ellipsometric analysis quality parameter by up to two orders of magnitude, especially for the low coverage cases. Comparison of the two models shows that the continuous film model overestimates the oil volume by less than 50 percent. Absolute numbers for backstreaming are in good agreement with published results for diffusion pumps. Good agreement was also found between the ellipsometric results and measurements done by x-ray photoelectron spectroscopy (XPS) and by scanning electron microscopy (SEM) on examples exposed to the same vacuum runs. Author

N92-13784*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
ENDOSCOPIC INSPECTION USING A PANORAMIC ANNULAR LENS Final Report
John A. Gilbert and Donald R. Matthys (Marquette Univ., Milwaukee, WI.) Dec. 1991 17 p
(Grant NAG8-159)
(NASA-CR-189490; NAS 1.26:189490) Avail: NTIS HC/MF A03 CSCL 20F

The objective of this one year study was to design, build, and demonstrate a prototype system for cavity inspection. A cylindrical view of the cavity interior was captured in real time through a compound lens system consisting of a unique panoramic annular lens and a collector lens. Images, acquired with a digitizing camera and stored in a desktop computer, were manipulated using image processing software to aid in visual inspection and qualitative analysis. A detailed description of the lens and its applications is given. Author

N92-13785# California Univ., Irvine.
TRANSIENT PHASE CONJUGATION Final Report, Sep. 1987 - Sep. 1990
Peter M. Rentzepis Jul. 1991 23 p
(Contract F29601-87-K-0057)
(AD-A240961; PL-TR-91-1015; AD-E200761) Avail: NTIS HC/MF A03 CSCL 20/6

During the past 3 years, material damage thresholds have been investigated as well as the magnitudes and response times of nonlinear susceptibilities of several important classes of optical materials. In addition, the Modified Twyman-Green Interferometer (MTGI) was invented. The MTGI determines both the magnitude and phase of the nonlinear susceptibility of a material relative to a known standard. This device has found significant acceptance within the optics research community. A phenomenon where energy may be exchanged between two frequency degenerate laser pulses has been characterized. Experimental investigations of optical phase conjugation via degenerate four wave mixing and beam coupling via degenerate two wave mixing using several nonlinear materials are compared. The components of the various physical phenomena which determine a nonlinear optical response as well as the interactions between these components are described. The strengths and weaknesses of the various optical materials and the utility of the MTGI are discussed. Finally, directions for future research are suggested. GRA

N92-13786# Naval Postgraduate School, Monterey, CA.
REAL TIME IMAGING OF INFRARED SCENE DATA GENERATED BY THE NAVAL POSTGRADUATE SCHOOL INFRARED SEARCH AND TARGET DESIGNATION (NPS-IRSTD) SYSTEM M.S. Thesis
Michael J. Baca Sep. 1990 60 p
(AD-A240983) Avail: NTIS HC/MF A04 CSCL 19/5

A system to display images generated by the Naval Postgraduate School Infrared Search and Target Designation (a modified AN/SAR-8 Advanced Development Model) in near real time was developed using a 33 MHz NIC computer as the central controller. This computer was enhanced with a Data Translation DT2861 Frame Grabber for image processing and an interface board designed and constructed at NPS to provide synchronization between the IRSTD and Frame Grabber. Images are displayed in false color in a video raster format on a 512 by 480 pixel resolution monitor. Using FORTRAN, programs have been written to acquire, unscramble, expand and display a 3 deg sector of data. The time line for acquisition, processing and display has been analyzed and repetition periods of less than four seconds for successive screen displays have been achieved. This represents a marked improvement over previous methods necessitating slower Direct Memory Access transfers of data into the Frame Grabber. Recommendations are made for further improvements to enhance the speed and utility of images produced. Author (GRA)

N92-13787# Kent State Univ., OH. Liquid Crystal Inst.
CHARACTERIZATION OF POLYMER DISPERSED LIQUID CRYSTAL SHUTTERS BY UV AND IR ABSORPTION SPECTROSCOPY Technical Report, 30 Jun. 1990 - 31 May 1991
J. L. West and R. Ondris-Crawford 31 May 1991 30 p
(Contract N00014-86-K-0766)
(AD-A241124) Avail: NTIS HC/MF A03 CSCL 20/6

Incorporation of dichroic dyes substantially improves the contrast of polymer dispersed liquid crystal (PDLC) shutters. The efficiency of dichroic dyes in a PDLC shutter depends on the scattering efficiency of the film, the dichroic ratio of the dye, the order parameter of the dye in the liquid crystal, and the fraction of dye dissolved in the droplets. Ultraviolet/visible (UV/VIS) spectroscopy can be effectively used to determine the scattering efficiency of PDLC films, and the distribution of dichroic dye dissolved in the liquid crystal droplets. To achieve high contrast the dichroic dye must be segregated in the droplet. We show that the segregation of dye in the PDLC droplets is dependent on the type of dye used and ranges from 19 to 100 percent. The scattering efficiency of the PDLC shutter provides insight into the effect of the dichroic dye on the contrast of the film. Production of a black PDLC shutter requires a mixture of several dichroic dyes. By careful consideration of the relative amounts of the components of the dye mixture, a black PDLC shutter can be constructed with a uniform contrast over the entire visible region. The dichroic absorption in the infrared of the liquid crystal used to make a PDLC can be analyzed in a manner analogous to the dichroic dye to determine the fraction of liquid crystal phase separated in droplets and dissolved in the polymer binder. GRA

N92-13788# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
GREEN THEOREMS AND QUALITATIVE PROPERTIES OF THE OPTICAL FLOW
Tomaso Poggio, Alessandro Verri, and Vincent Torre Apr. 1991 12 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124;

N00014-89-J-3139; NSF IRI-87-19394)
(AD-A241137; AI-M-1289; CBIP-P-67) Avail: NTIS HC/MF A03 CSCL 20/6

The optical flow is the field of apparent velocities derived from the time-dependent image. On the basis of computational arguments, it has been suggested that measurements of the optical flow may be used not for a quantitative estimate of physical 3D velocities for which the optical flow is illsuited, but rather for extracting qualitative properties, such as expansion or rotation. These qualitative properties relate directly to physically meaningful properties of the motion and of the 3D structure of the environment: for instance, expansion may signify a fast approach to a surface, that is an imminent crash, while detection of rotation and of its sign may be used to control egomotion. Detectors that could discriminate between translation, expansion, and rotation of the optical flow could be quite useful for several visual tasks, such as navigation. GRA

N92-13789 Department of the Navy, Washington, DC.
ELECTRO-OPTIC LINE NARROWING OF OPTICAL PARAMETRIC OSCILLATORS Patent
Bruce P. Boczar, inventor (to Navy) 2 Jul. 1991 7 p Filed 21 May 1990
(AD-D014987; US-Patent-5,028,816; US-Patent-Appl-SN-527966; US-Patent-Class-367-428) Avail: US Patent and Trademark Office CSCL 20/6

In the present invention a nonlinear crystal of an optical parametric oscillator is provided with a pump pulse and electrodes for applying a high voltage to the crystal during the pump pulse. The high voltage is switched from one level to another during the pump pulse duration. The initial value of the high voltage determines the position of the frequency center of the optical parametric oscillator gain profile because the indices of refraction are a function of the applied voltage due to the electro-optic effect. During the pump pulse, when the high voltage is switched to some other value, a new set of momentum and energy conservation conditions results. This causes a frequency shift in the gain profile. Thus the oscillator is provided with two differing gain profiles during the pump pulse. The output frequency of the oscillator is only those frequencies in both gain profiles. Author (GRA)

N92-13790# Arizona Univ., Tucson. Optical Sciences Center.
NONUNIFORMITY EFFECTS IN A HYBRID PLATINUM SILICIDE IMAGING DEVICE Final Report, 5 Feb. 1988 - 31 Jul. 1991
E. L. Dereniak and D. L. Perry 30 Sep. 1991 227 p
(Contract F19628-88-K-0009)
(AD-A241502) Avail: NTIS HC/MF A11 CSCL 17/5

The objective of this project was twofold. The first objective was to characterize the Hughes Aircraft Company CRC-365 platinum silicide imaging device in a staring infrared sensor system. The CRC-365 is a hybrid 256 x 256 IR focal plane array that operates in the 3-5 micrometer thermal infrared band. A complete sensor and computer interface were built for these tests, using plans provided by the Rome Laboratory at Hanscom Air Force Base, Massachusetts. Testing of the device revealed largely satisfactory performance, with notable exceptions in the areas of temporal response, temporal noise, and electrical crosstalk. The second objective of this research was to advance the understanding of how detector nonuniformity effects reduce the performance of sensors of this type. Notable accomplishments in this included a complete linear analysis of corrected thermal imaging in platinum silicide sensors, a nonlinear analysis of the CRC-365s expected performance, analysis of its actual performance when operated with nonuniformity correction, and the development of a new figure of merit. It was demonstrated that the CRC-365 is capable of maintaining background-noise-limited performance over at least a 40 K target temperature range, when operated with two-point nonuniformity correction. Author (GRA)

N92-13791# Gordon Research Conferences, Inc., Kingston, RI.
GORDON RESEARCH CONFERENCE ON HOLOGRAPHY AND OPTICAL INFORMATION PROCESSING Final Technical Report, 15 May - 15 Nov. 1991
John F. Walkup 9 Sep. 1991 13 p Conference held in Plymouth, NH, 17-21 Jun. 1991
(Grant AF-AFOSR-0186-91; AF Proj. 2305)
(AD-A241615) Avail: NTIS HC/MF A03 CSCL 20/6

The 1991 Gordon Research Conference on Holography and Optical Information Processing was held on 17-21 June, 1991 at Plymouth State College in Plymouth, NH. The talks on Ultrafast Optical Logic Using Solitons and Optical Processing with Planar Optics pointed out the significant progress being made by various Bell Labs investigators on various aspects of optical computing. Professor Sing Lee from the University of California-San Diego gave an excellent overview of some engineering and performance Issues in optoelectronic computing. It is clear that the Soviets have made considerable progress on multi transducer acousto-optic spectrum analyzers. It is also clear that the Japanese government is planning to continue to make optical computing one of its high priority areas, with its NIPT (New Information Processing Technology project), and are projected to continue to investigate so called sixth generation computer technologies. GRA

N92-13792# Army Missile Command, Redstone Arsenal, AL.
DIFFRACTION PATTERN ANALYSIS AS AN OPTICAL INSPECTION TECHNIQUE
Helga A. Alexander and Don A. Gregory Aug. 1991 29 p
(AD-A241724; AD-E951705; AMSMI/TR-RD-RE-90-3) Avail: NTIS HC/MF A03 CSCL 20/6

A few examples are presented which illustrate the usefulness of optical inspection techniques. Diffraction patterns produced by defects are often distinctive and can be used to examine objects nondestructively. It was also found that if the defect is minor and occupies only a small fraction of the illumination area, the defect diffraction pattern cannot be distinguished from the bright background. Author (GRA)

N92-13793# Lawrence Livermore National Lab., CA.
BROADBAND DIFFRACTIVE LENS
N. M. Ceglio, A. M. Hawryluk, R. A. London, L. G. Seppala, and D. P. Gaines (Brigham Young Univ., Provo, UT.) 28 May 1991 10 p Presented at the Optical Society of America (OSA) Conference on Short Wavelength Coherent Radiation, Monterey, CA, Dec. 1991
(Contract W-7405-eng-48)
(DE91-015186; UCRL-JC-107319; CONF-911236-1) Avail: NTIS HC/MF A02

Significant progress has been made toward solving the century-old problem of chromatic aberrations in diffractive optics. Our approach exploits modern materials and microfabrication technology and is very different from the purely diffractive strategy, which is commonly employed and which results in multiple diffractive elements separated by a finite distance. We have developed a Fresnel zone plate lens comprised of a serial stack of patterned minus-filters which allows broadband radiation to be focused (or imaged) without longitudinal or transverse chromatic aberrations. DOE

N92-13859*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
OPTICAL AND MECHANICAL RESPONSE OF HIGH TEMPERATURE OPTICAL FIBER SENSORS
Jim Sirkis *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 202-205 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N92-13794# Oak Ridge Y-12 Plant, TN.
COLD FUSION STUDIES
D. M. Hembree, L. A. Burchfield, E. L. Fuller, Jr., F. G. Perey, and G. Mamantov (Tennessee Univ., Knoxville.) 14 Jun. 1990 12 p
(Contract DE-AC05-84OS-21400)
(DE90-012885; Y/DK-669) Avail: NTIS HC/MF A03

A series of experiments designed to detect the by-products expected from deuterium fusion occurring in the palladium and titanium cathodes of heavy water, D2O, electrolysis cells is reported. The primary purpose of this account is to outline the integrated experimental design developed to test the cold fusion hypothesis and to report preliminary results that support continuing the investigation. Apparent positive indicators of deuterium fusion were observed, but could not be repeated or proved to originate from the electrochemical cells. In one instance, two large increases in the neutron count rate, the largest of which exceeded the background by 27 standard deviations, were observed. In a separate experiment, one of the calorimetry cells appeared to be producing approximately 18 percent more power that the input value, but thermistor failure prevented an accurate recording of the event as a function of time. In general, the tritium levels in most cells followed the slow enrichment expected from the electrolysis of D2O containing a small amount of tritium. However, after 576 hours of electrolysis, one cell developed a tritium concentration approximately seven times greater than expected level. DOE

N92-13795# Oak Ridge National Lab., TN.
EFFECT OF THE RADIAL ELECTRIC FIELD ON TURBULENCE
B. A. Carreras and V. E. Lynch 1990 34 p Presented at the Workshop on Transport and Confinement in Toroidal Devices, Santander (Spain), 2 Jul. 1990
(Contract DE-AC05-84OR-21400)
(DE90-012936; CONF-9007113-1) Avail: NTIS HC/MF A03

For many years, the neoclassical transport theory for three-dimensional magnetic configurations, such as magnetic mirrors, ELMO Bumpy Tori (EBT's), and stellarators, has recognized the critical role of the radial electric field in the confinement. It was in these confinement devices that the first experimental measurements of the radial electric field were made and correlated with confinement losses. In tokamaks, the axisymmetry implies that the neoclassical fluxes are ambipolar and, as a consequence, independent of the radial electric field. However, axisymmetry is not strict in a tokamak with turbulent fluctuations, and near the limiter ambipolarity clearly breaks down. Therefore, the question of the effect of the radial electric field on tokamak confinement has been raised in recent years. In particular, the radial electric field has been proposed to explain the transition from L-mode to H-mode confinement. There is some initial experimental evidence supporting this type of explanation, although there is not yet a self-consistent theory explaining the generation of the electric field and its effect on the transport. Here, a brief review of recent results is presented. DOE

N92-13796# Department of Energy, Washington, DC.
WORLD PROGRESS TOWARD FUSION ENERGY
J. F. Clarke Sep. 1989 20 p Presented at the 14th World Energy Conference, Montreal (Canada), 17-22 Sep. 1989
(DE90-625427; INIS-mf-12547; CONF-890901) Avail: NTIS (US Sales Only) HC/MF A03

This paper will describe the progress in fusion science and technology from a world perspective. The paper will cover the current technical status, including the understanding of fusion's economic, environmental, and safety characteristics. Fusion experiments are approaching the energy breakeven condition. An energy gain (Q) of 30 percent has been achieved in magnetic confinement experiments. In addition, temperatures required for an ignited plasma (Ti = 32 KeV) and energy confinements (about 75 percent of that required for ignition) have been achieved in separate experiments. Two major facilities have started the experimental campaign to extend these results and achieve or exceed Q = 1 plasma conditions by 1990. Inertial confinement fusion experiments are also approaching thermonuclear conditions and have achieved a compression factor 100-200 times liquid D-T. Because of this progress, the emphasis in fusion research is turning toward questions of engineering feasibility. Leaders of the major fusion R and D programs in the European Community (EC), Japan, the United States, and the U.S.S.R. have agreed on the major steps that are needed to reach the point at which a practical fusion system can be designed. The United States is preparing for an experiment to address the last unexplored scientific issue, the physics of an ignited plasma, during the late 1990's. The EC, Japan, U.S.S.R., and the United States have joined together under the auspices of the International Atomic Energy Agency (IAEA) to jointly design and prepare the validating R&D for an international facility, the International Thermonuclear Experimental Reactor (ITER), to address all the remaining scientific issues and to explore the engineering technology of fusion around the turn of the century. DOE

N92-13797# International Atomic Energy Agency, Vienna (Austria).
NUCLEAR FUSION: INEXHAUSTIBLE SOURCE OF ENERGY FOR TOMORROW
M. Leiser and V. Demchenko Sep. 1989 23 p Presented at the 14th World Energy Conference, Montreal (Canada), 17-22 Sep. 1989
(DE90-625428; INIS-mf-12551; CONF-890901) Avail: NTIS (US Sales Only) HC/MF A03

The purpose of this paper is to provide a general description of nuclear fusion as an energy option for the future and to clarify to some extent the various issues (scientific, technological, economic and environmental) which are likely to be relevant to controlled thermonuclear fusion. Section 1 describes the world energy problem and some advantages of nuclear fusion compared to other energy options. Sections 2 and 3 describe the fundamentals of fusion energy, plasma confinement, heating, and technological aspects of fusion researches. Some plasma confinement schemes (tokamak, stellarator, and inertial confinement fusion) are described. The main experimental results and parameter devices are cited to illustrate the state of the art as of 1989. Various engineering problems associated with reactor design, magnetic systems, materials, plasma purity, fueling, blankets, environment, economics, and safety are discussed. A description of both bilateral and multilateral efforts in fusion research under the auspices of the IAEA is presented in Section 4. DOE

N92-13798# Wisconsin Univ., Madison.
AN ENERGY CONFINEMENT STUDY OF THE MST (MADISON SYMMETRIC TORUS) REVERSED FIELD PINCH USING A THOMSON SCATTERING DIAGNOSTIC Ph.D. Thesis
D. J. DenHartog Nov. 1989 140 p
(Contract DE-FG02-85ER-53198)
(DE90-012021; DOE/ER-53198/146) Avail: NTIS HC/MF A07

Thomson scattering measurements of the central electron temperature and density during the plasma current peak have been performed on the MST Reversed Field Pinch (RFP). This Thomson scattering diagnostic was calibrated for absolute electron density measurements. These measurements of T(sub e) and n(sub e), when combined with profile assumptions, were used to calculate estimates of energy confinement time (tau(sub E)) and poloidal beta (beta(sub theta)). A standard discharge with I(sub p) approx. = 400 kA, F approx. = -0.1, and theta approx. = 1.6 typically exhibited T(sub e) approx. = 275 eV, n(sub e) approx. = 2.0 x 10(exp 13) cm(exp -3), tau(sub E) less than or = 1 ms, and beta(sub theta) less than or = 8 percent. The results of a limited plasma current scaling study did not indicate a strong scaling of T(sub e) or tau(sub E) with I(sub p). The Thomson scattering diagnostic was used in conjunction with a bolometer, VUV radiation monitor, and edge magnetic coils to study the loss of energy

from the plasma. Results indicate that thermal transport from stochastic magnetic fields, particle loss, and radiation are important energy loss processes. The experiments done for this study included an F-scan, a paddle limiter insertion series, and an argon doping series. The plasma maintained a constant beta(tau) during these perturbation experiments, suggesting that increases in one energy loss channel are compensated by drops in other channels and increases in input power to the plasma. DOE

N92-13799# Lawrence Livermore National Lab., CA.
THOMSON SCATTERING DIAGNOSTIC FOR THE MICROWAVE TOKAMAK EXPERIMENT
J. H. Foote, J. D. Barter, N. R. Sewall, J. J. Jolly, and L. F. Schlander May 1990 12 p Presented at the 8th Topical Conference on High-Temperature Plasma Diagnostics, Hyannis, MA, 6-10 May 1990
(Contract W-7405-eng-48)
(DE90-013487; UCRL-102938; CONF-900557-13) Avail: NTIS HC/MF A03

The Thomson-scattering diagnostic system (TSS) on the Microwave Tokamak Experiment (MTX) at LLNL routinely monitors electron temperature (T(sub e)) and density. Typical measured values at the plasma center under clean conditions are 900 +/- 70 eV and 1 to 2 x 10(exp 14) (+/- 30 percent) cm(exp -3). The TSS apparatus is compact, with all elements mounted on one sturdy, two-level optics table. Because of this, we maintain with minimum effort the alignment of both the ruby-laser input optics and the scattered-light collecting optics. Undesired background signals, e.g., plasma light as well as ruby-laser light scattered off obstacles and walls, are generally small compared with the Thomson-scattered signals we normally detect. In the MTX T(sub e) region, the TSS data are definitely fitted better when relativistic effects are included in the equations. Besides determining the temperature of the Maxwellian electron distribution, the system is designed to detect electron heating from GW-level free-electron laser (FEL) pulses by measuring large wavelength shifts of the scattered laser photons. TSS data suggest that we may indeed by able to detect these electrons, which can have energies up to 10 keV, according to computer simulation. DOE

N92-13800# Wisconsin Univ., Madison.
TRANSPORT AND FLUCTUATION IN REVERSED FIELD PINCHES
S. C. Prager Jun. 1990 13 p Presented at the 17th European Conference on Controlled Fusion and Plasma Heating, Amsterdam (Netherlands), 25-29 Jun. 1990
(Contract DE-FG02-85ER-53198)
(DE90-013641; DOE/ER-53198/156; CONF-900602-19) Avail: NTIS HC/MF A03

In the reversed field pinch various turbulent transport mechanisms might be simultaneously active, including MHD flow effects, free-streaming in a stochastic magnetic field, direct transfer of fluctuating energy to ions, and electrostatic fluctuation driven transport. By comparing fluctuations and transport in the RFP to that in the related toroidal configurations of the tokamak and stellarator, a greater understanding of toroidal confinement in general might be achieved. In addition to particle and energy transport, current tranport sustains the reversed field magnetic configuration and constitutes the dynamo effect. Recent results are available from RFP experiments on electrostatic fluctuations, anomalous ion heating, the presence of free-streaming fast electrons, and the extension of these effects to plasmas of large size. The reactor promise of the RFP is based upon the conjecture that the beta value will remain high and the resistance scaling classical, as has been the case in past experiments. One might expect beta to be limited by resistive interchange turbulence. The MST, RFX, and ZTH experiments will form a sequence of devices to test this scaling conjecture to large size and large current values. DOE

N92-13801# Wisconsin Univ., Madison.
UNIFIED FLUID/KINETIC DESCRIPTION OF MAGNETIZED PLASMAS
Zuoyang Chang and J. D. Callen Jun. 1991 43 p
(Contract DE-FG02-86ER-53218)
(DE91-018262; UW-CPTC-91-7) Avail: NTIS HC/MF A03

Unified fluid/kinetic equations for the plasma perturbed density (tilde n), parallel flow velocity (tilde u(parallel)) and temperature (tilde T) are developed in a sheared slab geometry by calculating the fluid moment closure relations kinetically. At first, a set of (unclosed) nonlinear perturbed fluid equations for (tilde n), (tilde u(parallel)) and (tilde T) is developed using a drift ordering analysis and a new gyroviscous force (del (center dot) Pi sub g). Thereafter, to develop linear closure relations for b (center dot) del (center dot) tilde Pi(parallel) and tilde q(parallel), a drift-kinetic version of a Chapman-Enskog-like (CEL) equation is developed and solved by using a moment approach and a physically realistic collision operator (Lorentz scattering operator plus the momentum restoring terms.) The resultant closure relations for b (center dot) del (center dot) tilde Pi(parallel) and tilde q(parallel) unify both the fluid and kinetic approaches. In the collisional fluid limit the equations reduce to the well-known Braginskii equations. In the adiabatic limit they reproduce the usual kinetic results, including Landau damping. It is shown that the CEL approach is more compatible with a fluid-like description of plasmas than the usual drift/gyro kinetic approach. A remarkable simplification of these complicated closure relations is achieved by using single power of plasma dispersion functions with modified arguments. The results are compared with other recently developed Landau damping models and shown to be more accurate, complete and physically meaningful. The resultant set of nonlinear fluid/kinetic equations (with linear closure relations) will be applied to various microinstabilities in tokamak plasmas and drift type microturbulence in a separate paper. DOE

N92-13802# Wisconsin Univ., Madison. Center for Plasma Theory and Computation.
UNIFIED FLUID/KINETIC DESCRIPTION OF MAGNETIZED PLASMAS
Zuoyang Chang and J. D. Callen Jul. 1991 35 p
(Contract DE-FG02-86ER-53218)
(DE91-018263; UW-CPTC-91-10) Avail: NTIS HC/MF A03

The unified fluid/kinetic equations developed in part 1 of this work are used to study plasma drift type microinstabilities. A generalized perturbed Ohm's law derived which is uniformly valid for arbitrary collisionality omega/nu and adiabaticity omega/k(parallel) upsilon(sub t). For electron drift waves we demonstrate that the collisional and collisionless drift wave instabilities can be uniformly described by replacing the Spitzer resistivity with a generalized pseudo-resistivity. Similarly, for ion drift type modes we obtain a uniformly valid dispersion relation for the ion temperature gradient modes (eta(sub i) modes). The eta(sub i) threshold as a function of ion-ion collisionality and ion Landau damping strength is addressed. Applying the unified equations to electron electromagnetic modes leads to generalized coupled equations for tilde phi and tilde A(parallel) which include electron Landau damping effects and are valid for any omega/nu. It is shown that the semi-collisional micro-tearing and drift-tearing modes of Drake and Lee can be easily reproduced in the appropriate limit. Generalization of the two-field Hasegawa-Wakatani turbulent equations to include electron temperature fluctuations and linear Landau damping effects is also discussed. Finally, a new method is presented to facilitate the study of magnetic trapped particle modes using our kinetic closure procedure. It is found that by including the trapped particle effects in the closure relations, the usual separation of the fluid equations into trapped and untrapped components becomes unnecessary. DOE

N92-13803# Texas Univ., Austin. Inst. for Fusion Studies.
SHOCK FORMATION IN A POLOIDALLY ROTATING TOKAMAK PLASMA
K. C. Shaing, R. D. Hazeltine, and H. Sanuki (National Inst. for Fusion Science, Nagoya, Japan) Jun. 1991 27 p
(Contracts DE-FG05-80ET-53088; DE-AC05-84OR-21400)
(DE91-018417; DOE/ET-53088/505; IFSR-505) Avail: NTIS HC/MF A03

When the Mach number M(sub p) of the poloidal rotation in a tokamak approaches unity, the poloidal variations of plasma density and potential appear to have the characteristics of a shock whose front lies on a plane (ribbon) of a fixed poloidal angle eta(sub 0). The shock first appears, when 1 - M(sub p) is approx. less than the square root of epsilon (epsilon is the inverse aspect ratio, on the inside of the torus at a shock angle eta(sub 0) is greater than or = pi if the plasma rotates counterclockwise poloidally. As M(sub p) increases, eta(sub 0) moves in the direction of the poloidal rotation. At M(sub p) = 1, eta(sub 0) = 2(pi). When M(sub p) - 1 is approx. less than the square root of epsilon, the shock angle is at eta(sub 0) approx. less than pi. The parallel viscosity associated with the shock is collisionality independent, in contrast to the conventional neoclassical viscosity. The viscosity reaches its maximum at M(sub p) = 1, which barrier that must be overcome to have a poloidal supersonic flow. Strong up-down asymmetric components of poloidal variations of plasma density and potential develop at M(sub p) approx. = 1. In the edge region, the convective poloidal momentum transport weakens the parallel viscosity and facilitates the transition from L-mode to H-mode. DOE

N92-13804# Wisconsin Univ., Madison. Dept. of Physics.
MANIFESTATIONS OF THE MHD AND KINETIC DYNAMO THROUGH SOFT X-RAYS Ph.D. Thesis
George Athanasios Chartas Aug. 1991 71 p
(Contract DE-FG02-85ER-53198)
(DE92-000162; DOE/ER-53198/181) Avail: NTIS HC/MF A04

The underlying mechanisms that produce and sustain the reversed toroidal field in RFP's are investigated by analyzing 2D x-ray emissivity reconstructions and by correlating the evolution of the hot electron properties to the reversed toroidal magnetic field. Reconnection of emissivity surfaces as seen in soft x-ray (SXR) reconstructions occur near the predicted resonant surface for the m = 1, n = -5,-6,-7 resistive tearing modes. Two distinct rates of reversed magnetic field generation are observed. First, in the MHD relaxation phase a sudden increase in B(sub t)(a) is detected. This event coincides with a large increase in the edge hot electron current density. The second mode of flux generation is observed to have a slower rate and occurs during the diffusion phase. A variation of the edge hot electron current density by a factor of four produced only a small change in the measured B(sub t)(a), implying the contributions of the hot electrons to the dynamo during the diffusion phase is small. Tilde-T(sub e, hot) / T(sub e, hot) was measured to be approximately 60 percent, which is much larger than the corresponding quantity for the bulk component which is about 30 percent. Scaling of the magnetic Reynolds number with the diffusion and MHD relaxation time, tau(sub MHD), indicated that the tau(sub MHD) does not have a strong dependence on the Spitzer resistivity whereas the diffusion time does depend on the classical resistivity. SXR emission mode analysis during the transition from a rotating to a locked plasma shows a decrease in the m = 1 Fourier Bastille component of the emissivity. This is due to the flattening of the emissivity profile as seen in the SXR reconstructions. DOE

N92-13805# Naval Research Lab., Washington, DC.
MODELING OF DYNAMIC BIPOLAR PLASMA SHEATHS
J. M. Grossmann, S. B. Swanekamp, and P. F. Ottinger 20 Aug. 1991 67 p
(AD-A240928; NRL-MR-6894) Avail: NTIS HC/MF A04 CSCL 20/9

The behavior of a one dimensional plasma sheath is described in regimes where the sheath is not in equilibrium because it carries current densities that are either time dependent, or larger than the bipolar Child-Langmuir level determined from the injected ion flux. Earlier models of dynamic bipolar sheaths assumed that ions and electrons evolve in a series of quasi-equilibria. In addition, sheath growth was described by the equation Zenoxs = (ji)-Zenouo, where xs is the velocity of the sheath edge, ji is the ion current density, nouo is the injected ion flux density, and Ze is the ion charge. In this paper, a generalization of the bipolar electron-to-ion current density ratio formula is derived to study regimes where ions are not in equilibrium. A generalization of the above sheath growth equation is also developed which is consistent with the ion continuity equation and which reveals new physics of sheath behavior associated with the emitted electrons and their evolution. Based on these findings, two new models of dynamic bipolar sheaths are developed. Larger sheath sizes and potentials than those of earlier models are found. In certain regimes, explosive sheath growth is predicted. GRA

N92-13806# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.
FUNDAMENTAL RESEARCH ON EROSION IN MAGNETOPLASMADYNAMIC THRUSTERS Annual Technical Report, Oct. 1990 - Oct. 1991
V. V. Subramaniam 1 Jul. 1991 42 p
(Grant AF-AFOSR-0360-87; AF Proj. 2308)
(AD-A241809; AFOSR-91-0891TR) Avail: NTIS HC/MF A03 CSCL 20/9

Significant developments have been made toward a comprehensive theory of Onset and erosion in steady-state self-field MPD thrusters. The Back-EMF Onset theory predicts that the middle region of the cathode (i.e., away from the inlet and exit) and the near inlet and exit regions of the anode are susceptible to severe erosion. This erosion occurs due to excessive electron bombardment at a critical value of the local sheath voltage drop (or current density). Furthermore, this theory predicts that the regions of potential and magnetic field oscillations observed at Onset occur predominantly in the high current density regions of the cathode (i.e., near the inlet and exit regions) and in the low current density regions at the anode. Past experimental observations at Princeton, and recent observations from Stuttgart support the predictions of this theory. The research described here provides a summary of the accomplishments and progress made during the final year under grant AFOSR-87-0360. GRA

N92-13807# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
NUMERICAL STUDY OF MULTIPOLE FIELD INFLUENCE ON PLASMA COOLING IN THETA PINCH
V. I. Romanovskij and V. V. Chudanov 1990 16 p In RUSSIAN; ENGLISH summary
(DE91-636496; IAE-5033-7) Avail: NTIS HC/MF A03

The influence of supplementary multipole magnetic field on heat losses by (theta)-pinch plasma through the chamber wall is considered. The derivation of the anisotropic thermal conduction equation, reflecting the complicated configuration of the magnetic field is presented; the method of its solution on nonorthogonal grids is written. DOE

N92-13808# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
ANALYTICAL DESCRIPTION OF THE VACUUM MAGNETIC CONFIGURATION OF THE URAGAN-2M TORSATRON AND BETA(SUB eq) RATIO EVOLUTION
V. D. Pustovitov 1990 39 p In RUSSIAN; ENGLISH summary
(DE91-636810; IAE-5012-6) Avail: NTIS HC/MF A03

The effect of additional longitudinal and transverse magnetic fields on the vacuum magnetic configuration of the stellarator is analyzed. The applicability of two approaches, a precise three-dimensional and an approximated two-dimensional one to describe the stellarators is discussed. The scalar two-dimensional equation of currentless plasma equilibrium in conventional stellarators with a large aspect ratio is analyzed. On this basis the effects which are of practical interest for the Uragan-2M installation currently under construction in KhFTI are studied. DOE

N92-13809# Los Alamos National Lab., NM.
ENERGETIC ALPHA PARTICLE DEPOSITION IN A MAGNETIZED PLASMA
D. P. Smitherman and R. C. Kirkpatrick 1991 6 p Presented at the 6th International Conference on Emerging Nuclear Energy Systems, Monterey, CA, 16-21 Jun. 1991

(Contract W-7405-eng-36)
(DE92-000316; LA-UR-91-2860; CONF-910626-13) Avail: NTIS HC/MF A02

The problem of energetic alpha particle deposition in a dense, magnetized deuterium-tritium (DT) thermonuclear fuel has been studied numerically for the case of coulomb interactions in cylindrical geometry. This was done by following the particle trajectories initiated at various radii and in different directions through the plasma and its imposed field until they had either left the plasma or deposited all their energy. The resulting complex particle trajectories in the static magnetized fuel make a detailed treatment of the problem computationally intensive. Therefore, we have attempted to use detailed modeling to produce a data base for a neural nets algorithm for incorporation in an ignition critical profile code. While the accuracy of the neutral net in reproducing the detailed calculated results is not high, it is approximately 6000 times faster. DOE

N92-13810# Oak Ridge National Lab., TN.
EVALUATION OF WELDMENTS IN TYPE 21-6-9 STAINLESS STEEL FOR COMPACT IGNITION TOKAMAK STRUCTURAL APPLICATIONS, PHASE 1
D. J. Alexander, G. M. Goodwin, and E. E. Bloom Jun. 1991 32 p
(Contract DE-AC05-84OR-21400)
(DE92-000379; ORNL/TM-11739-Phase-1) Avail: NTIS HC/MF A03

Primary design considerations for the Compact Ignition Tokamak toroidal field-coil cases are yield strength and toughness in the temperature range from 77 to 300 K. Type 21-6-9 stainless steel, also still known by its original Armco Steel Company trade name Nitronic 40, is the proposed alloy for this application. It has high yield strength and usually adequate base metal toughness, but weldments in thick sections have not been adequately characterized in terms of mechanical properties or hot-cracking propensity. In this study, weldability of the alloy in heavy sections and the mechanical properties of the resultant welds were investigated including tensile yield strength and Charpy V-notch toughness at 77 K and room temperature. Weldments were made in four different base metals using seven different filler metals. None of the weldments showed any indication of hot-cracking problems. All base metals, including weldment heat-affected zones, were found to have adequate strength and impact toughness at both test temperatures. Weld metals, on the other hand, except ERNiCr-3 and ENiCrFe-3, had impact toughnesses of less than 67 J at 77 K. Inconel 82 had an average weld metal impact toughness of over 135 J at 77 K, and although its strength at 77 K is less than that of type 21-6-9 base metal, at this point it is considered to be the first-choice filler metal. Phase 2 of this program will concentrate on composition refinement and process/procedure optimization for the generic ERNiCr-3 composition and will generate a design data base for base and weld metal, including tensile, fracture toughness, and crack growth rate data. DOE

N92-13811# Oak Ridge National Lab., TN.
FUSION ENERGY DIVISION Annual Progress Report, period ending 31 Dec. 1989
J. Sheffield, C. C. Baker, and M. J. Saltmarsh Jul. 1991 316 p
(Contract DE-AC05-84OR-21400)
(DE92-000388; ORNL-6624) Avail: NTIS HC/MF A14

The Fusion Program of Oak Ridge National Laboratory (ORNL) carries out research in most areas of magnetic confinement fusion. The program is directed toward the development of fusion as an energy source and is a strong and vital component of both the U.S. fusion program and the international fusion community. Issued as the annual progress report of the ORNL Fusion Energy Division, this report also contains information from components of the Fusion Program that are carried out by other ORNL organizations (about 15 percent of the program effort). The areas addressed by the Fusion Program and discussed in this report include the following: experimental and theoretical research on magnetic confinement concepts; engineering and physics of existing and planned devices, including remote handling, development, and testing of diagnostic tools and techniques in support of experiments; assembly and distribution to the fusion community of databases on atomic physics and radiation effects; development and testing of technologies for heating and fueling fusion plasmas; development and testing of superconducting magnets for containing fusion plasmas; development and testing of materials for fusion devices; and exploration of opportunities to apply the unique skills, technology, and techniques developed in the course of this work to other areas. Highlights from program activities are included in this report. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-13812# Duke Univ., Durham, NC. Dept. of Chemistry.
SYNTHESIS AND CHARACTERIZATION OF GALLIUM-ARSENIC COMPOUNDS CONTAINING A FOUR-MEMBERED Ga-As-Ga-Cl OR Ga-As-Ga-As RING: CRYSTAL STRUCTURES OF (Me3SiCH2)2 GaAs(SiMe3)2 Ga(CH2SiMe3)2 Cl AND ((Me3SiCH2)2 GaAs(SiMe3)2)2
Richard L. Wells, James W. Pasterczyk, Andrew T. McPhail, James D. Johnson, and Abbas Alvanipour 30 Oct. 1990 30 p
(Contract N00014-89-J-1545)
(AD-A229513; DU/DC/TR-16) Avail: NTIS HC/MF A03 CSCL 17/2

The third example of an organogallium four-membered ring compound with arsenic, halogen mixed bridging, Me3SiCH2 2GaAs SiMe3 2Ga CH2SiMe3 2Cl, was prepared by the reaction of Me3Si 3As with two equivalents of (Me3SiCH2)2GaCl. X-ray crystallographic analysis showed that the compound contains a nonplanar Ga-As-Ga-C1 ring. The crystals belong to the monoclinic system space group P21/c C52h with four molecules per unit cell of dimensions a 12.476, b 15.832, c22.279 A, Beta 108.87, V 4164(2) A3. The dimer Me3SiCH2 2GaAs SiMe3 22 was prepared by reaction of LiAs SiMe3 2 and Me3SiCH2 2GaCl. Its solid-state dimeric structure was established by single-crystal X-ray analysis. GRA

N92-13813*# Florida Inst. of Tech., Melbourne. Dept. of Physics and Space Sciences.
FURTHER IMPROVEMENTS IN PROGRAM TO CALCULATE ELECTRONIC PROPERTIES OF NARROW BAND GAP MATERIALS Semiannual Report, 15 Jun. - 15 Dec. 1991
James D. Patterson 15 Dec. 1991 39 p
(Grant NAG8-781)
(NASA-CR-189503; NAS 1.26:189503) Avail: NTIS HC/MF A03 CSCL 20L

Research into the properties of narrow band gap materials during the period 15 Jun. to 15 Dec. 1991 is discussed. Abstracts and bibliographies from papers presented during this period are reported. Graphs are provided. D.R.D.

N92-13814# Wales Univ. Inst. of Science and Technology, Cardiff. Dept. of Physics, Electronics and Electrical.
EXPERIMENTAL INVESTIGATION INTO THE EFFECT OF LONG TERM THERMAL ANNEALS ON THE THERMOELECTRIC PROPERTIES OF SILICON GERMANIUM-GALLIUM PHOSPHIDE Final Technical Report
D. M. Rowe Jun. 1991 41 p
(Contract DAJA45-89-C-0029)
(AD-A240806; R/D-6255-PH-01) Avail: NTIS HC/MF A03 CSCL 09/1

In this report is embodied the result of an experimental investigation into the effect of thermal anneals on the thermoelectric properties of n-type silicon germanium-gallium phosphide material. The construction of apparatus for measuring the electrical conductivity, Seebeck coefficient and thermal diffusivity is described and their performance assessed. A variety of techniques are employed in an attempt to identify the mechanisms/agencies

responsible for the reported enhanced thermoelectric properties of these materials after they have been subjected to high temperature thermal anneals. The results confirm that improvements in the electrical power factor of silicon germanium-gallium phosphide accompanies high temperature thermal annealing. GRA

N92-13815# Army Missile Command, Redstone Arsenal, AL. Systems Simulation and Development Directorate.
FURTHER APPLICATIONS OF A CRYSTAL LATTICE DISINTEGRATION CRITERION TO PREDICT SHOCK-INDUCED REACTIVE CONDITIONS IN SOLID MATERIALS Final Technical Report, Jan. 1989 - Jan. 1990
James P. Billingsley Jul. 1991 74 p
(AD-A240964; AD-E951699; AMSMI/TR-RD-SS-91-7) Avail: NTIS HC/MF A04 CSCL 19/4

Experimental data for several reactive (explosive) and inert materials have been examined, and the important particle velocities (V1 and VF) were computed. The associated shock velocity (Usf) and shock pressure (Psf) were also calculated to facilitate comparison with experimentally observed reactive or anomalous events. The explosives analyzes are: pressed TNT, PBX-9407, octol, pressed PETN, and crystal PETN. Three rather diverse inert materials are considered. They are: poly pyromellitimide (PPMI), iron, and sodium chloride (NaCl). PPMI is a complex polymeric compound whose low-pressure shock-loading behavior is highly non-linear. Author (GRA)

N92-13816# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
SOLID STATE RESEARCH Quarterly Technical Report, 1 Nov. 1990 - 31 Jan. 1991
Alan L. McWhorter 15 Feb. 1991 107 p
(Contract F19628-90-C-0002)
(AD-A241025; Rept-1991; Rept-1; ESD-TR-91-069) Avail: NTIS HC/MF A06 CSCL 09/1

This report covers in detail the research work of the Solid State Division at Lincoln Laboratory for the period 1 November 1990 through 31 January 1991. The topics covered are electrooptical devices, quantum electronics, materials research, submicrometer technology, high speed electronics, microelectronics, and analog device technology. Funding is provided primarily by the Air Force, with additional support provided by the Army, DARPA, Navy, SDIO, NASA, and DOE. GRA

N92-13817 Department of the Navy, Washington, DC.
MULTIPLE QUANTUM WELL DEVICE Patent
Carey Schwartz, inventor (to Navy) 30 Jul. 1991 7 p Filed 27 Sep. 1989
(AD-D015012; US-Patent-5,036,371; US-Patent-Appl-SN-413025; US-Patent-Class-357-16) Avail: US Patent and Trademark Office CSCL 09/1

A multiple quantum well device has a wide well and a plurality of narrower wells spaced from each other and sandwiched between a plurality of barriers and with quantum coupling existing between the wells. Semiconductor substrates and optimal well and barrier widths are selected to yield band gaps and charge localization within the wells such that the energy differences between the ground state of the wide well and the N excited states of a narrow wells correspond to the energy of a photon in the desired spectral range. GRA

N92-13818# Duke Univ., Durham, NC. Dept. of Chemistry.
ON THE SYNTHESIS AND CHARACTERIZATION OF NOVEL ALUMINUM-ARSENIC COMPOUNDS; CRYSTAL STRUCTURE OF Et2AlAs(SiMe3)22
Richard L. Wells, Andrew T. McPhail, and Timothy M. Speer 3 Oct. 1991 22 p
(Contract N00014-89-J-1545)
(AD-A241333; DU/DC/TR-24) Avail: NTIS HC/MF A03 CSCL 07/2

The viability of dehalosilylation and lithium chloride elimination reactions for use in the preparation of compounds containing core rings of the type was investigated. The second fully characterized aluminum-arsenic dimer, Et2AlAs(SiMe3)22, was isolated from a coupling reaction between Et2AlCl and LiAs(SiMe3)3 carried out at -78 C. Dehalosilylation reaction between Et2AlCl and As(SiMe3)3 in 1:1 and 2:1 mole ratios at ambient temperature failed to give the expected products, instead yielding the adduct Et2(Cl)Al As(SiMe3)3 (2). As evidenced by 1H NMR spectra, an NMR tube sample of 2 in benzene-d6 did undergo internal dehalosilylation when heated to 87 C in an oil bath. X-ray crystallographic analysis of 1 confirms its dimeric solid state structure and shows the Al-As-Al-As ring to be planar. Compound 1 crystallizes in the monoclinic system, space group C2/c (C2h6), with four molecules in a unit cell. GRA

N92-13819# Duke Univ., Durham, NC. Dept. of Chemistry.
SYNTHESIS AND CHARACTERIZATION OF COMPOUNDS CONTAINING THE As(SiMe3)2 BRIDGING GROUP: CRYSTAL STRUCTURES OF (t-Bu2GaAs(SiMe3)2)2 AND t-Bu2GaAs(SiMe3)2 Ga(t-Bu)2Cl
Richard L. Wells, Andrew T. McPhail, and Abbas Alvanipour 30 Oct. 1991 22 p
(Contract N00014-89-J-1545)
(AD-A241334; DU/DC/TR-23) Avail: NTIS HC/MF A03 CSCL 07/4

The compounds (t-Bu2GaAs(SiMe3)2)2 (1) and t-Bu2Ga-As(SiMe3)2Ga(t-Bu)2Cl (2) were not produced from reaction mixtures of t-Bu2GaCl with (Me3Si)3As (1:1 and 2:1 mole ratio mixtures) and only starting materials were recovered. However, t-Bu2GaCl reacts with LiAs(SiMe3)2*2THF to yield (1), which on reaction with t-Bu2GaCl affords (2) quantitatively. Compound (2) is the fifth example of a compound containing the Ga-As-Ga-X (X = Cl, Br) core, and the second wherein the organogallium four-membered ring with arsenic, halogen mixed bridging is not puckered. In addition to partial elemental analyses and nuclear magnetic resonance spectroscopic characterization data, the molecular structures have been elucidated by single crystal x ray diffraction methods. GRA

N92-13820# Naval Research Lab., Washington, DC.
PLASTICITY IN SHOCKED SINGLE CRYSTALS VIEWED BY PULSED X-RAY DIFFRACTION
Robert R. Whitlock and Justin S. Wark 5 Oct. 1991 7 p
(AD-A241404; NRL-MR-6874) Avail: NTIS HC/MF A02 CSCL 20/5

X-ray diffraction from single LiF crystals was performed parallel (Bragg orientation) and transverse (Laue orientation) to shock fronts generated by nanosecond laser pulses. Subgrain boundaries are noticeably affected by the shock. Transverse elastic strain with both tensile and compressive components is seen. These novel observations are interpreted as evidence of dislocation motion and the onset of plasticity. GRA

N92-13821# North Carolina State Univ., Raleigh.
GROWTH, CHARACTERIZATION AND DEVICE DEVELOPMENT IN MONOCRYSTALLINE DIAMOND FILMS Quarterly Letter Report, 1 Jul. - 30 Sep. 1991
Robert F. Davis, Jeffrey T. Glass, Klaus J. Bachmann, R. J. Nemanich, and R. J. Trew 30 Sep. 1991 52 p
(Contract N00014-90-J-1604)
(AD-A241505) Avail: NTIS HC/MF A04 CSCL 09/1

Investigations concerned with the out-diffusion of ion-implanted C atoms to the surface of monocrystals of Cu(100) under supersaturated conditions, the use of surfactants such as Ag to reduce the surface energy of the C species and studies involving the diffusion of dissolved C down thermal gradients have resulted in the formation of graphite at the surface or interface of the Cu crystals. Metal contacts of Ti deposited below 400 C have been shown to be rectifying. The Schottky barrier height has been measured by ARUPS to be 1.0 eV. Deposition or annealing above this temperature results in the formation of Ti-C bonding and the gradual enhancement of ohmic behavior. Studies concerned with the deposition of TiN by RPCVD have been initiated. It has also been shown that processing techniques, both growth and

annealing, have a significant effect on the electrical conductivity of diamond films, particularly at low temperatures. Activation energies from 0.1 eV to 1.1 eV (natural diamond = 1.4 eV) were measured. Finally the potential for diamond devices in microwave and millimeter wave applications have been extensively examined, the results of which are reported herein. GRA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-13822# California Inst. of Tech., Pasadena.
EXPERIMENTAL SIMULATION AND DIAGNOSTICS OF HIGH-ENTHALPY REAL-GAS FLOWS Annual Progress Report
1991 4 p
(Contract N00014-90-J-1305)
(AD-A241286) Avail: NTIS HC/MF A01 CSCL 20/11

The very high flow speeds (up to 8km/s) of transport to and from space through the earth's atmosphere are necessarily associated with very high temperatures (up to 10,000 K) in ground testing and research facilities. Therefore, such facilities have to operate only for very short test times. Various techniques have been devised for generating a test flow of sufficient speed and density to simulate the thermal and kinetic processes of high-temperature gasdynamics correctly. Of these, the shock tunnel and the expansion tube principle are the most successful, and in both cases the high enthalpy regime requires the driver gas to be heated transiently to high temperatures (up to 4,000 K). This can most conveniently be achieved by a piston compression. Many new and only partially understood effects occur in the flows associated with the NASP. Dissociative non-equilibrium effects in the external flow, mixing, and combustion processes in supersonic combustion ramjet engines and boundary layers in real-gas flows pose new problems that can presently not be solved by computational fluid dynamics (CFD) techniques. Key experimental data are needed to test and supply parameters for CFD methods. GRA

N92-13823# Naval Postgraduate School, Monterey, CA.
THE EFFECTS OF EMBEDDED VORTICES ON HEAT TRANSFER IN A TURBULENT BOUNDARY LAYER WITH FILM COOLING FROM HOLES WITH COMPOUND ANGLES M.S. Thesis
Stephen W. Mitchell Sep. 1990 255 p
(Contract MIPR-FY-1455-89-N0670)
(AD-A241359) Avail: NTIS HC/MF A12 CSCL 20/13

The effects of embedded longitudinal vortices on film cooling injectant from one row and two rows of holes with compound angles are investigated. Holes are designed such that their angle from the test surface is 30 degrees in a spanwise/normal plane projection, and 35 degrees in a streamwise/normal plane projection. A blowing ratio of 0.5, non-dimensional injection temperature parameters of 1.29 to 1.38, and freestream velocity of 10 m/s are employed. As the spanwise position of the vortex is altered. Stanton Numbers change considerably depending upon which portion of each vortex is proximate to film injection holes. These variations are vastly different depending on whether or not spanwise components of vortex secondary flows are opposed or aligned with the spanwise direction of the injectant. Mean velocity surveys, injection distribution surveys, and flow visualization results are also discussed. GRA

N92-13824# Army Construction Engineering Research Lab., Champaign, IL.
ALGORITHMS FOR SLAB-ON-GRADE HEAT TRANSFER CALCULATIONS Final Report
William P. Bahnfleth and JoAnn Amber Sep. 1990 86 p
(DA Proj. 4A1-61102-AT-23)
(AD-A241567; CERL-TR-E-90/15) Avail: NTIS HC/MF A05 CSCL 20/13

A major portion of a building's energy consumption can result from earth coupled heat transfer processes. Accurate prediction of heat transfer rates through floors, basements, bermed walls, and earth-covered roofs is a critical first step toward effective control of earth-coupled losses. Algorithms currently in use, both manual and numerical procedures, have fundamental flaws that make them unsatisfactory beyond the level of crude estimates. This report describes the development of two new algorithms for slab-on-grade heat loss calculations. A method suitable for manual use employs a geometric scaling based on the ratio of floor area to perimeter length. A multiple input transfer function method appropriate for implementation in energy analysis programs is built on a seven-node model of the floor/ground system. The models were validated through comparison with the results of an hourly, three-dimensional finite difference program. The results of this study will provide the basis for improving existing estimation methods and building simulation programs for military construction. GRA

N92-13825# Centro di Cultura Scientifica A. Volto, Como (Italy).
CHAOTIC BEHAVIOUR IN QUANTUM DYNAMICS Final Technical Report
G. Casati and I. Guarneri Sep. 1991 35 p
(Contract DAJA45-88-C-0003)
(AD-A241758; R/D-5653-PH-01) Avail: NTIS HC/MF A03 CSCL 20/5

The stability of atoms or molecules in external fields clearly depends on whether this phenomenon survives at least in part at the quantum level. It turns out that quantization has a strong effect on this diffusion. As a matter of fact, the study of a simple albeit abstract model (the so-called Kicked Rotator) yielded the remarkable results, that quantization strongly limits and even suppresses this type of diffusion. In other words, a classical system would continue to absorb energy from the external perturbing field, but its quantum version is much more stable and reaches after a while a sort of steady-state in which no energy is further absorbed. In the chaotic regime, the classical oscillator would display a host of different orbits that behave quite differently in spite of the closeness of their starting points (initial conditions); in the quantum case, all these wildly different dynamical possibilities interfere, thus leading the process of excitation to a halt. This phenomenon has been recognized to be analogous to the Anderson localization of Solid State Physics. GRA

N92-13826# Maryland Univ., College Park. Inst. for Physical Science and Technology.
THEORETICAL INVESTIGATIONS OF CHAOTIC DYNAMICS Final Report, 1 Jun. 1989 - 30 Nov. 1990
James Yorke Aug. 1991 11 p
(Grant AF-AFOSR-0401-89; AF Proj. 2304)
(AD-A241790; AFOSR-91-0879TR) Avail: NTIS HC/MF A03 CSCL 12/4

One of the outstanding problems of chaotic dynamics has been to show that chaos develops monotonically as the parameter is varied, for some systems. Results along this line have been very few. An overview of these results has been given in the proposal for this funding period. Kan and Yorke have discovered results in two dimensions which clearly indicate the situation is far worse than previously believed. Their results require some mild nondegeneracy conditions. Their results are for diffeomorphisms that depend on a parameter. They show that monotonicity never occurs in two dimensions as the parameter varies, except in the most trivial situations. In (KY) these results have been written for a specical prototype example which seems quite typical. This example has nice simple choices of coordinates, and analysis is facilitated. Establishment of the full result was much more difficult and the analysis has been carried out in (KKY). GRA

N92-13827# International Centre for Theoretical Physics, Trieste (Italy).
ON RELIABILITY OF SINGULAR-VALUE DECOMPOSITION IN ATTRACTOR RECONSTRUCTION
M. Palus and I. Dvorak Dec. 1990 39 p
(DE91-633960; IC-90/413) Avail: NTIS HC/MF A03

Applicability of singular-value decomposition for reconstructing the strange attractor from one-dimensional chaotic time series, proposed by Broomhead and King, is extensively tested and discussed. Previously published doubts about its reliability are confirmed: singular-value decomposition, by nature a linear method, is only of a limited power when nonlinear structures are studied.
DOE

N92-13828# International Centre for Theoretical Physics, Trieste (Italy).
THE MAGNETIC TOP AS A MODEL OF QUANTUM SPIN
A. O. Barut, M. Bozic, and Z. Maric (Belgrade Univ., Yugoslavia) Dec. 1990 44 p
(DE91-633988; IC-90/460) Avail: NTIS HC/MF A03

The magnetic top is defined by the property that the external magnetic field B couples to the angular velocity (omega)-vector, as distinct from the top whose magnetic moment is independent of angular velocity. This allows one to construct a gauge theory of the top where the canonical angular momentum (s) is analogous to the canonical momentum of the point particle and the B field plays the role of the gauge potential. The magnetic top has four constants of motion so that Lagrange equations for Euler angles, (theta), phi, chi (which define the orientation of the top) are solvable, and are solved here. Although the Euler angles have complicated motion, the canonical angular momentum, interpreted as spin, obeys precisely a simple precession equation. The Poisson brackets of s(sub 1) allow us further to make an unambiguous quantization of spin, leading to the Pauli spin Hamiltonian. The use of canonical angular momentum alleviates the ambiguity in the ordering of the variables (theta), phi, chi, p(sub theta), p(sub phi), p(sub chi) in the Hamiltonian. A detailed gauge theory of the asymmetric magnetic top is also given.
DOE

N92-13829# International Centre for Theoretical Physics, Trieste (Italy).
ON THE PRINCIPLE OF GAUGE INVARIANCE IN THE FIELD THEORY WITH CURVED MOMENTUM SPACE
R. M. Mir-Kasimov Nov. 1990 7 p
(DE91-634059; IC-90/407) Avail: NTIS HC/MF A02

The gauge transformations consistent with the hypothesis of the curved momentum space are considered. In this case, the components of the electromagnetic field are not commuting. The finite-difference analogue of the D'Alambert equation is derived.
DOE

N92-13830# International Centre for Theoretical Physics, Trieste (Italy).
CANONICAL QUANTIZATION OF QCD IN AXIAL TYPE GAUGE AND THE PROBLEM OF SPURIOUS SINGULARITY
P. A. Saponov and G. E. Boos Dec. 1990 10 p
(DE91-634062; IC-90/427) Avail: NTIS HC/MF A02

We consider the problem of quantization of QCD in the axial-type gauge n(sub mu)A(sub a)(sup mu) = 0 in terms of only physical degrees of freedom in the gluon field components. The gauge conditions and the Gauss law turn out to be valid as operator equations and spurious singularity is totally absent in the gluon propagator. The value of n(exp 2) proves to be immaterial therefore axial, light-cone and temporal gauges can be elaborated on the same base.
DOE

N92-13831# International Centre for Theoretical Physics, Trieste (Italy).
CAN GRAVITY DO WHAT HIGGS DOES?
M. Pawlowski Dec. 1990 10 p
(DE91-634575; IC-90/454) Avail: NTIS HC/MF A02

Conformally invariant model unifying gravity with the Standard Model is proposed. It is based on the observation that the conformal factor couples to matter fields analogously as the Higgs field does; so, for the proper choice of coupling parameters, it can cancel divergences connected with longitudinal boson exchange. The criteria of stability, renormalizability and proper Einsteinian limit suggest that higher derivative terms are necessary in the gravitational sector. This introduces one new parameter, but two old parameters of the Higgs potential are redundant due to unification. The Planck mass becomes a dynamical parameter characterizing gravitational background in accordance with Mach's philosophy. Cosmological constant appears in a natural way.
DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N92-13832*# Old Dominion Univ., Norfolk, VA.
NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM, 1991
Surendra N. Tiwari, comp. Sep. 1991 270 p Fellowship program held in Hampton, VA, 3 Jun. - 9 Aug. 1991
(Grant NGT-47-003-029)
(NASA-CR-187598; NAS 1.26:187598) Avail: NTIS HC/MF A12 CSCL 05I

In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spent 10 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society of Engineering Education supervises the programs. The objects were the following: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of the participants' institutions; and (4) to contribute to the research objectives of the NASA center. For individual titles, see N92-13833 through N92-13870.

N92-13833*# Florida Univ., Gainesville. Dept. of Aerospace Engineering, Mechanics, and Engineering Science.
CALIBRATION OF A TUNABLE EXCIMER LASER USING THE OPTOGALVANIC EFFECT **c36**
John D. Abbitt *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 58-60 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20E

A device for the calibration of a tunable excimer laser is currently under development. The laser provides UV radiation at three principal wavelengths, 193, 248, and 308 nm and is tunable over a range of 1 nm at each of these wavelengths. The laser is used as a non-intrusive optical probe to excite electronic transitions, and thereby induce fluorescence, of the principle molecules or atoms of interest in supersonic flowfields, both reacting and nonreacting. The fluorescence resulting from the excitation is observed with an intensified camera. Over the range of tunability at the three wavelengths are a number of transitions that can be observed. The intensity of the fluorescence depends in part on the local temperature and density. The nature of this thermodynamic dependence is variable among transitions; thus, identification of the transition under observation is required. The specific transition excited corresponds directly to the wavelength of the radiation. The present technique used for transition identification consists of scanning the laser across the range of tunability and observing the fluorescence resulting from various molecular transitions.
Author

N92-13834*# Hampton Univ., VA. Dept. of Mass Media Arts.
THE HL-20 AS THE PERSONNEL LAUNCH SYSTEM **c14**
Sherilee F. Beam *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 61-67 (For primary document

see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 14B

To ensure manned access to space, the Personnel Launch System (PLS) is under consideration by NASA as a complement to the Space Shuttle. Its primary mission will be to transport crew and passengers to and from the Space Station Freedom in low earth orbit (LEO). There are currently two design studies being funded: a biconic, ballistic-shaped vehicle at JSC and a lifting body concept at LaRC. In the late 1950's, both NASA and the Air Force were engaged in the study of lifting bodies for LEO vehicles. Projects included the M2F2 series, the X24 series, and the HL-10. These lifting bodies derive their lift solely from the shape of the fuselage. By the mid-1960's, full scale models were actually built and tested with some success and some failure. Langley's HL-10 was one of the most successful of these projects. However, these studies were temporarily shelved while work progressed on the Space Shuttle. Some of the test results from these studies actually led to concept refinements on certain aspects of the Space Shuttle development. Due to the more recent successes of the Space Shuttle Program and a directive to place a Space Station in orbit, there has been renewed interest in developing a lifting body vehicle as the PLS. The vehicle, the HL-20, is an LaRC Project in the Space Systems Division, involving the efforts of a number of individuals. Data on the research carried out for peer and lay review has been available in hard copy format, but a need existed for actual video footage, combined with scientific visualization technology, for presentation and archival purposes. The purpose of this project was to satisfy this need. Author

N92-13835*# University of South Florida, Tampa. Dept. of Civil Engineering and Mechanics.
COMPARISON OF POLYNOMIAL APPROXIMATIONS AND ARTIFICIAL NEURAL NETS FOR RESPONSE SURFACES IN ENGINEERING OPTIMIZATION **c61**
William C. Carpenter *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 68-80 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09B

Engineering optimization problems involve minimizing some function subject to constraints. In areas such as aircraft optimization, the constraint equations may be from numerous disciplines such as transfer of information between these disciplines and the optimization algorithm. They are also suited to problems which may require numerous re-optimizations such as in multi-objective function optimization or to problems where the design space contains numerous local minima, thus requiring repeated optimizations from different initial designs. Their use has been limited, however, by the fact that development of response surfaces randomly selected or preselected points in the design space. Thus, they have been thought to be inefficient compared to algorithms to the optimum solution. A development has taken place in the last several years which may effect the desirability of using response surfaces. It may be possible that artificial neural nets are more efficient in developing response surfaces than polynomial approximations which have been used in the past. This development is the concern of the work. Author

N92-13836*# Hampton Univ., VA. Dept. of Chemistry.
COMPUTATIONAL MODELLING OF POLYMERS **c27**
Edward A. Celarier *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 81-82 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11C

Polymeric materials and polymer/graphite composites show a very diverse range of material properties, many of which make them attractive candidates for a variety of high performance engineering applications. Their properties are ultimately determined largely by their chemical structure, and the conditions under which they are processed. It is the aim of computational chemistry to be able to simulate candidate polymers on a computer, and determine what their likely material properties will be. A number of commercially available software packages purport to predict the material properties of samples, given the chemical structures of their constituent molecules. One such system, Cerius, has been in use at LaRC. It is comprised of a number of modules, each of which performs a different kind of calculation on a molecule in the programs workspace. Particularly, interest is in evaluating the suitability of this program to aid in the study of microcrystalline polymeric materials. One of the first model systems examined was benzophenone. The results of this investigation are discussed. Author

N92-13837*# Murray State Univ., KY. Dept. of Physics and Astronomy.
INVESTIGATION OF THE EXCITED STATE IODINE LIFETIME IN THE PHOTODISSOCIATION OF PERFLUOROALKYL IODIDES **c25**
Stephen H. Cobb *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 83-84 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 07D

An evaluation of prospective laser materials for a space-based solar pumped laser system over the past decade has resulted in the identification of the iodine photodissociation laser as that system best suited to solar-pumped high energy operation. The active medium for the solar-pumped iodine photodissociation laser is from the family of perfluoroalkyl iodides. These lasants have the general form C(n)F(2n + 1)I, often abbreviated as RI. These iodides are known to exhibit photodissociaiton of the C-I bond when irradiated by near UV photons. The focus was on the experimental determination of the lifetime of the excited iodine atom following photodissociation of C4F9I, and also to monitor fluorescence from the iodine molecule at 500 nm to determine if I2 is being produced in the process. Photodissociation is achieved using an XeCl excimer laser with an output wavelength of 308 nm. The XeCl beam is focused into the middle of a cylindrical quartz cell containing the lasant. The laser pulse is detected with a fast risetime photomultiplier tube as it exits the cell. Other aspects of the investigation are discussed. Author

N92-13838*# Valparaiso Univ., IN. Dept. of Mechanical Engineering.
EXPERIENCES WITH OPTIMIZING AIRFOIL SHAPES FOR MAXIMUM LIFT OVER DRAG **c02**
Michael L. Doria *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 98-99 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

The goal was to find airfoil shapes which maximize the ratio of lift over drag for given flow conditions. For a fixed Mach number, Reynolds number, and angle of attack, the lift and drag depend only on the airfoil shape. This then becomes a problem in optimization: find the shape which leads to a maximum value of lift over drag. The optimization was carried out using a self contained computer code for finding the minimum of a function subject to constraints. To find the lift and drag for each airfoil shape, a flow solution has to be obtained. This was done using a two dimensional Navier-Stokes code. Author

N92-13839*# Norfolk State Univ., VA. Dept. of Chemistry and Physics.
EXPERIMENTAL DETERMINATION OF RESIDUAL STRESS **c39**
Milton W. Ferguson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 100-102 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20K

Residual stresses in finished parts have often been regarded as factors contributing to premature part failure and geometric distortions. Currently, residual stresses in welded structures and railroad components are being investigated. High residual stresses

formed in welded structures due primarily to the differential contractions of the weld material as it cools and solidifies can have a profound effect on the surface performance of the structure. In railroad wheels, repeated use of the brakes causes high residual stresses in the rims which may lead to wheel failure and possible derailment. The goals of the study were: (1) to develop strategies for using x-ray diffraction to measure residual stress; (2) to subject samples of Inconel 718 to various mechanical and heat treatments and to measure the resulting stress using x-ray diffraction; and (3) to measure residual stresses in ferromagnetic alloys using magnetoacoustics. Author

N92-13840*# Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Aeronautical Engineering.
PROPER ORTHOGONAL DECOMPOSITION BASED TURBULENCE MODELING c34
Mark N. Glauser *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 103-110 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20D

The proper orthogonal decomposition is utilized to provide one mode estimates of various turbulence quantities in the near-wall region of the turbulent boundary layer. The experimental data of Herzog (1986) and the direct numerical simulation (DNS) results of Zang (1991) proved the two-point correlation tensor. The correlation tensor is then used as the kernel in the integral eigenvalue problem from which the proper orthogonal modes are obtained. The one mode estimates of the turbulent kinetic energy, dissipation, and triple moments all exhibit the proper asymtotic behavior near the wall. As a validation test, a model for the triple moments is developed and its near-wall behavior is studied. This information can then be used to obtain an estimate of the damping function near the wall, which is then compared to known existing behavior. Since this is an initial investigation, the streamwise and spanwise dependence is surpressed and only the wall normal direction (y+) behavior of various turbulence statistics near the wall is studied. Before examining one mode estimates of the triple moments and the dissipation (on which the model is based), various second order moments are examined. If these do not exhibit the proper behavior near the wall (as discussed by Speziale et al 1990) it does not seem reasonable to expect the one mode estimate of the triple moment and dissipation to have the right behavior. Only the results obtained using the experimental data of Herzog are discussed since the results from the simulations of Zang exhibit similar behavior as discussed above. Author

N92-13841*# Christopher Newport Coll., Newport News, VA. Dept. of Physics.
THE ROLE OF TIME AND SPEED IN NASA'S SUNLITE PROGRAM c36
Joseph C. Hafele *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 111-114 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20E

The SUNLITE program of NASA's LaRC aims to demonstrate lower noise and better frequency stability for continuous-wave (CW) solid-state lasers in the microgravity environment of space. The program will utilize laser-diode-pumped nonplanar-ring oscillators regulated by ultra-stable high-finesse Fabry-Perot Spectrometers to produce light beams with phase rate or frequency variations as low as 3 Hz. SUNLITE will use the period-method (P-method) to measure the phase rate and frequency stability of the lasers. The P-method was chosen because it requires less memory space for the raw data, because frequencies can be analyzed on-line in real-time simply by reciprocating the periods (fi = 1/pi), and because the mean and variance of the frequencies can be calculated as fast or faster than they can be with the fastest fast Fourier transformations. Furthermore, for a given signal-to-noise power ratio, the P-method requires less data and less computer time to extract the noise components. Although the P-method does require fast Time Interval Counters, the Fourier transformation method requires comparably fast Sampling Volt meters. For either method, however, time and computer speed play a critical role. Author

N92-13842*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
FORMULATION OF THE LINEAR MODEL FROM THE NONLINEAR SIMULATION FOR THE F18 HARV c05
Charles E. Hall, Jr. *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 115-116 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01C

The F-18 HARV is a modified F-18 Aircraft which is capable of flying in the post-stall regime in order to achieve superagility. The onset of aerodynamic stall, and continued into the post-stall region, is characterized by nonlinearities in the aerodynamic coefficients. These aerodynamic coefficients are not expressed as analytic functions, but rather in the form of tabular data. The nonlinearities in the aerodynamic coefficients yield a nonlinear model of the aircraft's dynamics. Nonlinear system theory has made many advances, but this area is not sufficiently developed to allow its application to this problem, since many of the theorems are existance theorems and that the systems are composed of analytic functions. Thus, the feedback matrices and the state estimators are obtained from linear system theory techniques. It is important, in order to obtain the correct feedback matrices and state estimators, that the linear description of the nonlinear flight dynamics be as accurate as possible. A nonlinear simulation is run under the Advanced Continuous Simulation Language (ACSL). The ACSL simulation uses FORTRAN subroutines to interface to the look-up tables for the aerodynamic data. ACSL has commands to form the linear representation for the system. Other aspects of this investigation are discussed. Author

N92-13843*# Hampton Univ., VA.
A NUMERICAL METHOD FOR UNSTEADY AERODYNAMICS VIA ACOUSTICS c02
Steve Hodge *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 119-122 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

Formal solutions to the wave equation may be conveniently described within the framework of generaiized function theory. A generalized function theory is used to yield a formulation and formal solution of a wave equation describing oscillation of a flat plate from which a numerical method may be derived. Author

N92-13844*# Saint Paul's Coll., Lawrenceville, VA. Dept. of Business and Education.
MANPOWER AND PROJECT PLANNING c81
David W. Johnson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 123-124 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 05A

The purpose was to study how manpower and projects are planned at the Facilities Engineering Division (FENGD) within the Systems Engineering and Operations Directorate of the LaRC and to make recommendations for improving the effectiveness and productivity ot the tools that are used. The existing manpower and project planning processes (including the management plan for the FENGD, existing manpower planning reports, project reporting to LaRC and NASA Headquarters, employee time reporting, financial reporting, and coordination/tracking reports for procurement) were discussed with several people, and project planning software was evaluated. Author

N92-13845*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
ANALYSIS OF SIMULATED IMAGE SEQUENCES FROM SENSORS FOR RESTRICTED-VISIBILITY OPERATIONS c54

Rangachar Kasturi *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 125-128 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 05H

A real time model of the visible output from a 94 GHz sensor, based on a radiometric simulation of the sensor, was developed. A sequence of images as seen from an aircraft as it approaches for landing was simulated using this model. Thirty frames from this sequence of 200 x 200 pixel images were analyzed to identify and track objects in the image using the Cantata image processing package within the visual programming environment provided by the Khoros software system. The image analysis operations are described. Author

N92-13846*# Pennsylvania State Univ., University Park. Dept. of Engineering Science and Mechanics.
SQUEEZE FLOW AND COMPACTION BEHAVIOR OF TOUGHENED POLYIMIDE MATRIX COMPOSITES c24
Byung Lip Lee, R. Pater, and M. D. Soucek *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 129-133 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11D

The main emphasis was placed upon the squeeze flow and compaction behavior of the Lewis Research Center (LaRC) research project series polyimide matrix composites. The measurement of squeeze film flow behavior was performed by a plastometer which monitors the change of thickness of a prepreg specimen laid between two parallel plates under the specified temperature and pressure history. A critical evaluation of the plastometer data was attempted by examining the morphology of the specimen at various points during the squeeze flow. The effects of crosslinks (Mc) of resin, imidization (B-ataging) condition, and pressure on the squeeze flow behavior were examined. Results are given. Author

N92-13847*# Wichita State Univ., KS. Dept. of Industrial Engineering.
APPLICATION OF MULTIPLE CRITERIA DECISION METHODS IN SPACE EXPLORATION INITIATIVE DESIGN AND PLANNING c12
Abu S. M. Masud *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 134-141 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 22A

Fellowship activities were directed towards the identification of opportunities for application of the Multiple Criteria Decision Making (MCDM) techniques in the Space Exploration Initiative (SEI) domain. I identified several application possibilities and proposed demonstration application in these three areas: evaluation and ranking of SEI architectures, space mission planning and selection, and space system design. Here, only the first problem is discussed. The most meaningful result of the analysis is the wide separation between the two top ranked architectures, indicating a significant preference difference between them. It must also be noted that the final ranking reflects, to some extent, the biases of the evaluators and their understanding of the architecture. Author

N92-13848*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
THE USE OF ARTIFICIAL NEURAL NETWORKS IN EXPERIMENTAL DATA ACQUISITION AND AERODYNAMIC DESIGN c02
Andrew J. Meade, Jr. *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 142-145 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

It is proposed that an artificial neural network be used to construct an intelligent data acquisition system. The artificial neural networks (ANN) model has a potential for replacing traditional procedures as well as for use in computational fluid dynamics validation. Potential advantages of the ANN model are listed. As a proof of concept, the author modeled a NACA 0012 airfoil at specific conditions, using the neural network simulator NETS, developed by James Baffes of the NASA Johnson Space Center. The neural network predictions were compared to the actual data. It is concluded that artificial neural networks can provide an elegant and valuable class of mathematical tools for data analysis. Author

N92-13849*# Wichita State Univ., KS. Dept. of Aerospace Engineering.
AN EVALUATION OF PRELIMINARY DOPPLER GLOBAL VELOCIMETRY MEASUREMENTS c02
L. Scott Miller *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 146-149 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

A review of Doppler Global Velocimetry (DGV) data obtained during wind tunnel tests on a 75 degree swept delta wing was performed. High frequency variations observed in normalized data files are attributed to image alignment problems. Unfortunately, initial DGV velocity data compared poorly with baseline reference data. Nonlinear DGV system operation during the tests is the likely source of this problem. Corrected data compares much more favorably and suggests that DGV is a valid measurement technique. Future DGV investigations should include a method or means for monitoring laser frequency relative to the ALF transfer function behavior. Author

N92-13850*# Florida Univ., Gainesville. Dept. of Chemical Engineering.
CONVECTION IN VERTICAL BRIDGMAN CONFIGURATIONS c33
Ranga Narayanan *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 161-162 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09C

We are interested in tracing the convective profiles of vertical Bridgman growth in two configurations, the pure Rayleigh convective mode and the combined Rayleigh-Marangoni mode. In order to do so, we conducted a numerical investigation that involved a finite volume calculation. The governing equations were integrated about a cell volume, using the Gauss Theorem and the volume variables like temperature and velocity were related to the surface variables. In order to solve for the pressure field, we employed the continuity equation and the residuals resulted in a Poisson equation. Results and comments for the Rayleigh and Marangoni problems in a vertical cylinder or Bridgman configuration are given. Author

N92-13851*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
IMPLEMENTATION OF THE LANCZOS EIGEN-SOLVER FOR THE CSI CODE ON HIGH PERFORMANCE COMPUTERS c61
Duc T. Nguyen *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 163-168 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09B

The focus of this research is to implement a Lanczos algorithm for the Control-Structure Integration (CSI) code which can exploit both parallel and vector capabilities provided by modern, high performance computers. A partial restoring orthogonality scheme is also developed and incorporated into the basic Lanczos algorithm. The numerical performance of the proposed parallel-vector Lanczos algorithm is demonstrated by solving for the frequencies and mode shapes of the Phase Zero CSI model. The superior performance of the Lanczos algorithm is illustrated in tabular form. Author

N92-13852*# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
MECHANICAL PROPERTIES OF 2D AND 3D BRAIDED TEXTILE COMPOSITES **c24**
Timothy L. Norman *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 169-172 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11D

The purpose of this research was to determine the mechanical properties of 2D and 3D braided textile composite materials. Specifically, those designed for tension or shear loading were tested under static loading to failure to investigate the effects of braiding. The overall goal of the work was to provide a structural designer with an idea of how textile composites perform under typical loading conditions. From test results for unnotched tension, it was determined that the 2D is stronger, stiffer, and has higher elongation to failure than the 3D. It was also found that the polyetherether ketone (PEEK) resin system was stronger, stiffer, and had higher elongation at failure than the resin transfer molding (RTM) epoxy. Open hole tension tests showed that PEEK resin is more notch sensitive than RTM epoxy. Of greater significance, it was found that the 3D is less notch sensitive than the 2D. Unnotched compression tests indicated, as did the tension tests, that the 2D is stronger, stiffer, and has higher elongation at failure than the RTM epoxy. The most encouraging results were from compression after impact. The 3D braided composite showed a compression after impact failure stress equal to 92 percent of the unimpacted specimen. The 2D braided composite failed at about 67 percent of the unimpacted specimen. Higher damage tolerance is observed in textiles over conventional composite materials. This is observed in the results, especially in the 3D braided materials. Author

N92-13853*# Ohio State Univ., Columbus. Dept. of Psychology.
INCORPORATING AFFECTIVE BIAS IN MODELS OF HUMAN DECISION MAKING **c81**
Thomas E. Nygren *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 173-175 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 05A

Research on human decision making has traditionally focused on how people actually make decisions, how good their decisions are, and how their decisions can be improved. Recent research suggests that this model is inadequate. Affective as well as cognitive components drive the way information about relevant outcomes and events is perceived, integrated, and used in the decision making process. The affective components include how the individual frames outcomes as good or bad, whether the individual anticipates regret in a decision situation, the affective mood state of the individual, and the psychological stress level anticipated or experienced in the decision situation. A focus of the current work has been to propose empirical studies that will attempt to examine in more detail the relationships between the latter two critical affective influences (mood state and stress) on decision making behavior. Author

N92-13854*# Longwood Coll., Farmville, VA. Dept. of Natural Sciences.
THE USE OF CARBORANES AS OXIDATION INHIBITORS FOR CARBON-CARBON COMPOSITES **c24**
John T. Petty *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 176-180 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11D

Carbon-carbon composites have many beneficial properties for use in aerospace applications, including their high specific strength and modulus at elevated temperatures. However, they share with all carbon based substances a strong tendency to burn when heated in air. In order to exploit their good qualities, it is necessary to slow or prevent their oxidation during use. Molecular inhibiters offer protection with the advantage of being able to form a homogeneous solution with the resin. Since boron oxides are known to provide the desired kind of protection, molecular compounds based on boron seem reasonable candidates to test as inhibitors. Performance tests indicated that carboranes are excellent materials for obtaining high uniform loadings of boron inhibitors in glassy carbon materials and thus reducing their rates of oxidation. Further, there is evidence that the use of substituted derivatives could provide more complete and thorough forms of protection. Author

N92-13855*# Puerto Rico Univ., Mayaguez. Dept. of Electrical and Computer Engineering.
NATURALLY INDUCED SECONDARY RADIATION IN INTERPLANETARY SPACE: PRELIMINARY ANALYSES FOR GAMMA RADIATION AND RADIOISOTOPE PRODUCTION FROM THERMAL NEUTRON ACTIVATION **c72**
Heriberto Plaza-Rosado *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 181-185 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20H

Thermal neutron activation analyses were carried out for various space systems components to determine gamma radiation dose rates and food radiation contamination levels. The space systems components selected were those for which previous radiation studies existed. These include manned space vehicle radiation shielding, liquid hydrogen propellant tanks for a Mars mission, and a food supply used as space vehicle radiation shielding. The computational method used is based on the fast neutron distribution generated by the BRYNTRN and HZETRN transport codes for Galactic Cosmic Rays (GCR) at solar minimum conditions and intense solar flares in space systems components. The gamma dose rates for soft tissue are calculated for water and aluminum space vehicle slab shields considering volumetric source self-attenuation and exponential buildup factors. In the case of the lunar habitat with regolith shielding, a completely exposed spherical habitat was assumed for mathematical convenience and conservative calculations. Activation analysis of the food supply used as radiation shielding is presented for four selected nutrients: potassium, calcium, sodium, and phosphorus. Radioactive isotopes that could represent a health hazard if ingested are identified and their concentrations are identified. For nutrients soluble in water, it was found that all induced radioactivity was below the accepted maximum permissible concentrations. Author

N92-13856*# University of Western Carolina, Cullowhee, NC. Dept. of Mathematics and Computer Science.
ANALYSIS OF PRESSURE-BROADENED OZONE SPECTRA IN THE 3 MICRON REGION **c45**
Eleanor S. Prochaska *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 186-189 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 13B

This work involves the analysis of a series of McMath Fourier Transform Infrared (FTIR) spectra of ozone broadened by mixing with air (four different pressures), nitrogen (three pressures), or oxygen (three pressures). Each spectrum covers the region from 2396 to 4057 cm(-1). This study focused on the 3 sub nu sub 3 band in t 3000 to 3060 cm(-1). The band is analyzed by first dividing its region into small intervals containing a few well isolated absorption lines of reasonable intensity. Each of these small intervals is fit by multiple iterations of the nonlinear least squares program until residuals (the difference between calculated and observed spectrum, as a percent of the strongest intensity in the interval) are minimized to a reasonable value which corresponds to the noise level of the measured spectrum. Position, intensity, and half-width are recorded for later analysis. From the measured half-widths, a pressure broadening coefficient was determined for each absorption line. Pressure shifts were determined by comparing observed line positions in the spectra of the diluted ozone samples to tabulated line positions determined from spectra of pure gas samples. Comparisons to other work on ozone indicate that the

broadening and shift coefficients determined in this study are consistent with those determined in other spectral regions.
Author

N92-13857*# Polytechnic Univ., Brooklyn, NY. Dept. of Mathematics.
CRITICAL PROBLEMS OF COMPUTATIONAL AEROACOUSTICS **c71**
Joel C. W. Rogers *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 190-197 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20A

The aeroacoustics of rigid boundaries is discussed. Lighthill gave a formulation of this problem in which he showed that the sources of the acoustic field were quadrupole in nature. We have preferred a different formulation of the problem, in which the quadrupoles are sources for a nonlinear wave equation, as opposed to the linear one used by Lighthill. This is given here in a figure which also gives further details of a solution procedure for the Euler equations appropriate for the aeroelastic problem and motivated by the analysis of Crow. In accordance with our formulation, we contend that an algorithm for accurate solutions of an inhomogeneous nonlinear wave equation is of prime importance. Author

N92-13858*# Appalachian State Univ., Boone, NC. Dept. of Mathematical Sciences.
BACKGROUND ISSUES FOR ON-LINE AIRCRAFT DOCUMENTATION **c06**
C. Ray Russell *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 198-201 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01D

Currently, almost all aircraft documentation in commercial aircraft cockpits is presented via hardcopy manuals. Several recent projects are aimed at eliminating all paper documentation in cockpits using electronic libraries. Electronic libraries encompass diverse information bases including aircraft system documentation, operations and procedures, checklists, maintenance logs, minimum equipment lists, maps and charts, and flight management information. These electronic libraries are envisioned to be embedded in the avionics so as to provide real time monitoring and display of information. Background issues are examined (motivation, information retrieval models, and preliminary designs) for the on-line presentation of aircraft systems documentation including operations, procedures, and checklists. Author

N92-13859*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
OPTICAL AND MECHANICAL RESPONSE OF HIGH TEMPERATURE OPTICAL FIBER SENSORS **c74**
Jim Sirkis *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 202-205 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20F

The National Aerospace Plane (NASP) will experience temperatures as high as 2500 F at critical locations in its structure. Optical fiber sensors were proposed as a means of monitoring the temperature in these critical regions by either bonding the optical fiber to, or embedding the optical fiber in, metal matrix composite (MMC) components. Unfortunately, the anticipated NASP temperature ranges exceed the glass transition region of the optical fiber glass. The attempt is made to define the operating temperature range of optical fiber sensors from both optical and mechanical perspectives. A full non-linear optical analysis was performed by modeling the optical response of an isolated sensor cyclically driven through the glass transition region. Author

N92-13860*# Kentucky Univ., Lexington. Dept. of Electrical Engineering.
FURTHER EVALUATION OF THE CONSTRAINED LEAST SQUARES ELECTROMAGNETIC COMPENSATION METHOD **c32**
William T. Smith *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 206-209 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20N

Technologies exist for construction of antennas with adaptive surfaces that can compensate for many of the larger distortions caused by thermal and gravitational forces. However, as the frequency and size of reflectors increase, the subtle surface errors become significant and degrade the overall electromagnetic performance. Electromagnetic (EM) compensation through an adaptive feed array offers means for mitigation of surface distortion effects. Implementation of EM compensation is investigated with the measured surface errors of the NASA 15 meter hoop/column reflector antenna. Computer simulations are presented for: (1) a hybrid EM compensation technique, and (2) evaluating the performance of a given EM compensation method when implemented with discretized weights. Author

N92-13861*# Syracuse Univ., NY. Dept. of Mechanical and Aerospace Engineering.
CONSTANT-TEMPERATURE ANEMOMETRY MEASUREMENTS IN HYPERSONIC BOUNDARY LAYERS **c02**
Eric F. Spina *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 210-212 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

One of the major unresolved issues in fluid dynamics is the nature of apparent stresses, called Reynolds stresses, which occur in turbulent boundary layers. In hypersonic boundary layers, the flow physics is further complicated by the large temperature and density fluctuations and the concomitant contamination of the Reynold stresses by fictitious terms. Because of the severe flow environment and the extraordinary demands on sensors and instruments, the turbulence characteristics of hypersonic boundary layers were studied in only a cursory fashion. The plans for supersonic (HSCT) and hypersonic (NASP) vehicles made supersonic flow physics one of the critical pacing technologies in aerospace science. In particular, experimental data are needed to verify candidate computer models and to reach an important understanding of the turbulence physics. The presented research is the start of a substantial effort to refine existing instrumentation and develop experimental techniques to measure the various component of the Reynolds stress in hypersonic boundary layers.
Author

N92-13862*# Hampton Univ., VA. Dept. of Chemistry.
POTENTIAL APPROACHES TO THE SPECTROSCOPIC CHARACTERIZATION OF HIGH PERFORMANCE POLYMERS EXPOSED TO ENERGETIC PROTONS AND HEAVY IONS **c27**
Naushadalli K. Suleman *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 213-214 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11C

A potential limitation to human activity on the lunar surface or in deep space is the exposure of the crew to unacceptably high levels of penetrating space radiations. The radiations of most concerns for such missions are high-energy protons emitted during solar flares, and galactic cosmic rays which are high-energy ions ranging from protons to iron. The development of materials for effective shielding from energetic space radiations will clearly require a greater understanding of the underlying mechanisms of radiation-induced damage in bulk materials. This can be accomplished in part by the detailed spectroscopic characterization of bulk materials that were exposed to simulated space radiations. An experimental data base thus created can then be used in

conjunction with existing radiation transport codes in the design and fabrication of effective radiation shielding materials. Electron Paramagnetic Resonance Spectroscopy was proven very useful in elucidating radiation effects in polymers (high performance polymers are often an important components of structural composites). Author

N92-13863*# Missouri Univ., Columbia. Nuclear Engineering Program.

CONDENSATIONAL GROWTH AND TRACE SPECIES SCAVENGING IN STRATOSPHERIC SULFURIC ACID/WATER AEROSOL DROPLETS c45

Robert V. Tompson, Jr. *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 215-220 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 13B

Stratospheric aerosols play a significant role in the environment. The composition of aerosols is believed to be a liquid solution of sulfuric acid and water with numerous trace species. Of these trace species, ozone in particular was recognized as being very important in its role of shielding the environment from harmful ultraviolet radiation. Also among the trace species are HCl and ClONO2, the so called chlorine reservoir species and various oxides of nitrogen. The quantity of stratospheric aerosol and its particle size distribution determines, to a large degree, the chemistry present in the stratosphere. Aerosols experience 3 types of growth: nucleation, condensation, and coagulation. The application of condensation investigations to the specific problem of stratospheric aerosols is discussed. Author

N92-13864*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PREPARATION OF ATOMIC OXYGEN RESISTANT POLYMERIC MATERIALS c27

Victor J. Tortorelli (Ursinus Coll., Collegeville, PA.), P. M. Hergenrother, and J. W. Connell *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 221-226 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 11C

Polyphenyl quinoxalines (PPQs) are an important family of high performance polymers that offer good chemical and thermal stability coupled with excellent mechanical properties. These aromatic heterocyclic polymers are potentially useful as films, coatings, adhesives, and composite materials that demand stability in harsh environments. Our approach was to prepare PPQs with pendent siloxane groups using the appropriate chemistry and then evaluate these polymers before and after exposure to simulated atomic oxygen. Either monomer, the bis(o-diamine)s or the bis(alpha-diketone)s can be synthesized with a hydroxy group to which the siloxane chain will be attached. Several novel materials were prepared. Author

N92-13865*# Old Dominion Univ., Norfolk, VA. Dept. of Engineering Management.

SPACECRAFT DESIGN OPTIMIZATION USING TAGUCHI ANALYSIS c18

Resit Unal *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 227-228 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 22B

The quality engineering methods of Dr. Genichi Taguchi, employing design of experiments, are important statistical tools for designing high quality systems at reduced cost. The Taguchi method was utilized to study several simultaneous parameter level variations of a lunar aerobrake structure to arrive at the lightest weight configuration. Finite element analysis was used to analyze the unique experimental aerobrake configurations selected by Taguchi method. Important design parameters affecting weight and global buckling were identified and the lowest weight design configuration was selected. Author

N92-13866*# Delaware Univ., Newark. Dept. of Physics and Astronomy.

LINE NARROWING OF AgGaSe2 OPTICAL PARAMETRIC OSCILLATOR BY INJECTION SEEDING c45

George H. Watson, Norman Barnes, and Keith Murray *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 229-231 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 13B

Solid-state lasers are developed for atmospheric applications. Optical parametric oscillators (OPO) are being investigated as sources of tunable radiation in the 2.5-12 micron range where development of conventional lasers is subject to numerous difficulties. Parametric oscillation is a nonlinear optical technique for converting laser output to longer wavelengths. Incident photons, typically from a pulsed pump laser, are converted into two photons of longer wavelength, while satisfying energy conservation. The particular split of energy is determined by momentum conservation; the wavelength of interest is usually selected by angle orientation of the nonlinear material with respect to the direction of propagation of the pump beam. An OPO based on AgGaSe2 was considered. Author

N92-13867*# Texas Univ., Austin. Dept. of Mechanical Engineering.

THE EFFECT OF A TYPE 3 AND TYPE 4 SHOCK/SHOCK INTERACTION ON HEAT TRANSFER IN THE STAGNATION REGION c34

Dennis Wilson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 232-235 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20D

One of the major engineering challenges in designing the National Aerospace Plane, NASP, is to overcome augmented heating on the intake cowl lip from shock/shock interactions. The shock/shock interaction arises when the bow shock from the craft's nose interferes with the bow shock from the cowl lip. Considering only the region immediately around the cowl lip, the problem geometry may be simplified as that of an oblique shock impinging on a bow shock from a circular cylinder. Edney classified six different interference patterns resulting from an oblique-shock/curved bow-shock interaction. Of these six types, type 3 and 4 are most significant in that augmented surface heat transfer may be ten to thirty times greater than the case without the shock/shock interaction. The objective was to begin to develop a mathematical model which is capable of predicting the effect of a type 3 and 4 shock/shock interaction in the stagnation region of an arbitrary 2-D body. This model must be capable of predicting the maximum surface heat flux and the surface stagnation point pressure once the outer (effectively inviscid) flowfield is given. Therefore, it must capture the unsteady physics of the impinging shear layer. Author

N92-13868*# California State Univ., Los Angeles. Dept. of Mechanical Engineering.

NAVIER-STOKES CALCULATION OF TRANSONIC FLOW PAST THE NTF 65 DEG DELTA WING c02

Chivey C. Wu *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 236-247 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 01A

Models of four delta wings were built and tested in the 8 x 8 ft Transonic Wind Tunnel at LaRC. The wings are identical in planform shape with a swept-back angle of 65 degrees, but bear different leading edge profiles. The models were tested under pressurized and cryogenic conditions to simulate true flight Reynolds numbers. Data on the aerodynamic forces and pressure distributions at various locations on the wings were taken at various flight Mach numbers and angles of attack. Effects of high Reynolds number and leading edge radius on the aerodynamic characteristics of the wings are being accessed. To thoroughly understand the

turbulent, vortical flow around the wings, an effort to perform computational aerodynamic analysis is being made. The objective of the analysis is to supplement and validate the experimental data and explain the high Reynolds number and leading edge effects. GRIDGEN, a software developed by General Dynamics, is being used to generate the grid topology for the flow field around the wings. The flow solver to be used is CFL3D, a computation fluid dynamics code developed at LaRC. Based on the geometric description of the wings, a FORTRAN program called WINGSURF was written to generate the databases defining the surface geometry of the wings. To match the true geometry of the models in the wind tunnel for realistic comparison with experimental results, databases defining the sting support for the wing models were also created by two other FORTRAN programs, STINJOIN and STINREAR. Listing of the programs are attached and the geometry of a typical wing model with the sting support is shown. Other aspects of the investigation are discussed.
Author

N92-13869*# Polytechnic Univ., Brooklyn, NY. Dept. of Civil Engineering.
OBJECT ORIENTED DEVELOPMENT OF ENGINEERING SOFTWARE USING CLIPS **c61**
C. John Yoon *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 248-249 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 09B

Engineering applications involve numeric complexity and manipulations of a large amount of data. Traditionally, numeric computation has been the concern in developing an engineering software. As engineering application software became larger and more complex, management of resources such as data, rather than the numeric complexity, has become the major software design problem. Object oriented design and implementation methodologies can improve the reliability, flexibility, and maintainability of the resulting software; however, some tasks are better solved with the traditional procedural paradigm. The C Language Integrated Production System (CLIPS), with deffunction and defgeneric constructs, supports the procedural paradigm. The natural blending of object oriented and procedural paradigms has been cited as the reason for the popularity of the C++ language. The CLIPS Object Oriented Language's (COOL) object oriented features are more versatile than C++'s. A software design methodology based on object oriented and procedural approaches appropriate for engineering software, and to be implemented in CLIPS was outlined. A method for sensor placement for Space Station Freedom is being implemented in COOL as a sample problem. Author

N92-13870*# California Polytechnic State Univ., San Luis Obispo. Dept. of Electronic Engineering Technology.
ON THE CONTROL ASPECT OF LASER FREQUENCY STABILIZATION **c36**
Omar Zia *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 250-253 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 20E

Realization of frequency stable lasers is viewed as key to progress in many areas of research; therefore, the search for more effective techniques of frequency stabilization has intensified significantly in recent years. Investigating and validating the fundamental linewidth and frequency stability limits of a Nd:YAG laser oscillator, locked to a high finesse reference cavity in the microgravity and vibration-free environment of space, is the objective of a NASA project called SUNLITE at LaRC. The objective of this paper is to further investigate the application of feedback control theory in active frequency control as a frequency stabilization technique and determine the most appropriate control strategy to be used in general and particularly in the SUNLITE Project. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N92-13871# Government-Univ.-Industry Research Roundtable, Washington, DC.
THE IMPACT OF THE USE OF EXPANDED AUTHORITIES WITHIN THE FEDERAL DEMONSTRATION PROJECT
1 Feb. 1991 33 p
(Contract DE-FG05-89ER-75498)
(DE91-013941; DOE/ER-75498/10) Avail: NTIS HC/MF A03

When we set out on our mission two years ago, we wanted to accomplish two things: expand the demonstration to a larger national project with the same level of effectiveness and efficiency that had developed in Florida, and to confirm what had been experienced in Florida -- increased scientific productivity as a result of cutting the red tape of research administration. In Florida, we clearly saw that time was being saved by trimming administrative tasks which were not adding value to the process. What we did not have in Florida was strong empirical evidence indicating that the effort saved was translated into scholarly activities. Not only has the project expanded successfully; it is now providing the much needed confirmation that released time is indeed being channeled into scientific and research productivity. This report caps two years of streamlining, simplifying, testing and monitoring our approach to Federal support of research. The results have been overwhelming. We saved time for 2501 participating Principal Investigators (PIs). Individually, PIs saved annually in excess of 5 days. This amounts to a 2 percent savings in their yearly effort. With PIs claiming they allot 10 percent to 20 percent of their time to administrivia required by the conditions of Federal sponsorship, this savings translates to a 15 percent reduction in time spent on administrative tasks. DOE

N92-13872# General Accounting Office, Washington, DC. Information Management and Technology Div.
FAA PROCUREMENT: COMPETITION FOR MAJOR DATA-PROCESSING PROJECT WAS UNJUSTIFIABLY LIMITED. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON TRANSPORTATION AND RELATED AGENCIES, COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES
JayEtta Z. Hecker Jun. 1990 15 p
(GAO-IMTEC-90-71; GAO/IMTEC-90-38; GAO/IMTEC-89-44FS; B-239902) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

The General Accounting Office (GAO) reviewed the Federal Aviation Administration's (FAA) acquisition approach for its Computer Resources Nucleus (CORN) project. Under CORN an FAA contractor would provide, maintain, and operate computer facilities, equipment, systems software, and technical support to meet FAA mission and program needs for data processing services, and provide optional processing support to other organizations within the Department of Transportation (DOT). Specifically GAO investigated whether a single architecture requirement in the CORN request for proposals may have unnecessarily limited competition. GAO determined that in FAA's request for proposals the agency did not define key functional requirements for achieving its objectives, such as those pertaining to data accessibility, and therefore FAA (1) unjustifiably limited competition and restricted the range of solutions that vendors could offer, and (2) dictated a system design that may not satisfy the agency's needs. GAO recommended that the contract scheduled to be awarded in mid-1990 not be awarded until FAA has fully specified the agency's functional requirements whenever possible. DOT and FAA officials disagreed with GAO's conclusions and recommendation, maintaining that the single architecture requirement is necessary to achieve FAA's information goals, was a judgment based on how the agency should do its business, and did not require detailed written justification. J.P.S.

N92-13873# General Accounting Office, Washington, DC. Information Management and Technology Div.
NASA ADP PROCUREMENT: CONTRACTING AND MARKET SHARE INFORMATION. FACT SHEET FOR CONGRESSIONAL REQUESTERS
Jack L. Jr. Brock, comp. Apr. 1990 27 p
(GAO/IMTEC-90-39FS; GAO/IMTEC-89-66FS; GAO/IMTEC-90-28FS; GAO/IMTEC-90-35FS; B-238835) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

This report focuses on specific aspects of NASA's ADP-related procurements. It includes the number and aggregate dollar value of their mainframe-related contracts, distribution of procurements among equipment manufacturers, and breakdown of various procurement methods used to obtain mainframe-related equipment. It also includes data on NASA's procurements of mainframe computer operating system software. NASA's procurements are grouped by the General Accounting Office (GAO) under sole source new contracts, new contracts that resulted from competitive procedures where only one offeror remained in the procurement at the time the awardee was selected, new contracts that resulted from competitive procedures where the awardee was selected from among multiple competitors, and new contracts with system developers and integrators - except any contracts separately categorized as awarded to 8(a) firms. Also obtained and analyzed were data on NASA's modifications to existing contracts, the use of GSA's multiple award schedule contracts, and other miscellaneous procurement methods. J.P.S.

N92-13874# General Accounting Office, Washington, DC.
PAPERWORK CLEARANCE: IT'S TIME FOR A CHANGE
Eleanor Chelimsky 12 Oct. 1989 27 p
(GAO/T-PEMD-90-6) Avail: NTIS HC/MF A03

The General Accounting Office (GAO) reports to the House Subcommittee on Science, Research, and Technology on the adequacy with which the Office of Management and Budget (OMB) has implemented the Paperwork Reduction Act of 1980, and where changes are needed. Specifically examined were (1) how and how well OMB handles agencies' requests to collect information, (2) how OMB's reviews have influenced agencies' decisions to collect information, and (3) the likely consequences of these actions for the availability of data. OMB and agencies' practices appear to have had positive, neutral, negative, and Catch 22 influences on the likely availability of information. Examples of these influences are presented. A 14 to 23 percent reduction in research oriented submissions is noted and one agency stated that OMB's criterias thwart the development of research. GAO recommends a number of changes including delegation of primary review responsibility to agencies with demonstrated capability for such review, and training OMB personnel in the proper applications of its policies, criteria, and timing of reviews of information requests. J.P.S.

N92-13875# Air Force Academy, CO.
MULTICRITERIA EVALUATION OF LOT SIZING TECHNIQUES AS A FUNCTION OF DEMAND PATTERN, TIME BETWEEN ORDERS, AND DEMAND VARIABILITY Final Report
Bryan S. Cline, Bobbie L. Foote, and Robert E. Schlegel Apr. 1991 16 p Prepared in cooperation with Oklahoma Univ., Norman
(AD-A240799; USAFA-TR-91-5) Avail: NTIS HC/MF A03 CSCL 05/1

The interactive effects of demand pattern (classified according to forecasting difficulty), cost structure (represented by time between orders), and demand variability on the performance of five lot sizing techniques (Eisenhut Part Period Balance, EOQ, Silver-Meal, Tsado, and Wagner-Whitin heuristic) were evaluated using empirical demand data from local businesses. Three performance criteria were used: inventory cost relative to the Wagner-Whitin optimal, number of stockouts, and percentage short per stockout. The results indicate that selecting the best algorithm depends on the performance criterion selected. EOQ, Tsado, and Silver-Meal performed best with respect to relative inventory cost, while Eisenhut and Wagner-Whitin heuristic performed best with respect to the shortage criteria. Percentage short per stockout was affected by differences in forecasting difficulty. The effect was constant across all techniques. Significant differences among all three classes of demand variability were found for all three criteria. Level of forecasting difficulty and variability do not affect the optimal choice of lot sizing technique if focus forecasting is used. GRA

N92-13876# Naval Postgraduate School, Monterey, CA.
A TESTBED TO EVALUATE COGNITIVE FEEDBACK THEORIES M.S. Thesis
Paul K. Larson Mar. 1991 58 p
(AD-A241813) Avail: NTIS HC/MF A04 CSCL 05/1

Researchers have begun to use a variety of process tracing techniques to understand the cognitive processes underlying decision making and the effects of feedback on decision making. This study describes a computer program which monitors repetitive decision making behavior to allow researchers to infer the cognitive processes that underlie the use of decision feedback. This program has a number of commands which provide researchers with many ways to present decision data and feedback. The program uses a computer mouse and information board to implement process tracing based on the information acquisition search methodology. Brunswik's lens model is used as the decision making paradigm. GRA

N92-13877*# Computer Technology Associates, Inc., Rockville, MD.
PLANNING AND SCHEDULING LESSONS LEARNED STUDY, EXECUTIVE SUMMARY Final Report, Jan. - Jun. 1990
Toni Robinson 29 Jun. 1990 53 p
(Contract NAS5-30680)
(NASA-CR-189507; NAS 1.26:189507) Avail: NTIS HC/MF A04 CSCL 05A

The study was performed to document the lessons on planning and scheduling activities for a number of missions and institutional facilities in such a way that they can be applied to future missions; to provide recommendations to both projects and Code 500 that will improve the end-to-end planning and scheduling process; and to identify what, if any, mission characteristics might be related to certain lessons learned. The results are a series of recommendations of both a managerial and technical nature related to the underlying lessons learned. Author

N92-13844*# Saint Paul's Coll., Lawrenceville, VA. Dept. of Business and Education.
MANPOWER AND PROJECT PLANNING
David W. Johnson *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 123-124 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 05A

N92-13853*# Ohio State Univ., Columbus. Dept. of Psychology.
INCORPORATING AFFECTIVE BIAS IN MODELS OF HUMAN DECISION MAKING
Thomas E. Nygren *In* Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 Sep. 1991 p 173-175 (For primary document see N92-13832 04-80)
Avail: NTIS HC/MF A12 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-13878# Fermi National Accelerator Lab., Batavia, IL.
FERMILAB LIBRARY DIRECTIONS
P. Garrett and D. Ritchie May 1990 3 p Presented at the 1st Inter-Laboratory Workshop on Preprint Database Management, Geneva, Switzerland 14-16 May 1990
(Contract DE-AC02-76CH-03000)
(DE90-013525; FNAL-TM-1668; CONF-9005239-2) Avail: NTIS HC/MF A01

In this document, we indicate our current thinking about the directions of the Fermilab Library. The ideas relate to the preprint management issue in a number of ways. The ideas are subject to revision as we come to understand what is possible as well as what is needed by the Laboratory community. This document should therefore be regarded as our personal view--the availability of off-the-shelf technology, of funding as well as feedback from the laboratory community about their needs will all affect how far we actually proceed in any of these directions. DOE

N92-13879 Pittsburgh Univ., PA.
ACCESS TO GEOGRAPHIC CONCEPTS IN ONLINE BIBLIOGRAPHIC FILES: EFFECTIVENESS OF CURRENT PRACTICES AND THE POTENTIAL OF A GRAPHIC INTERFACE Ph.D. Thesis
Linda Ladd Hill 1990 212 p
Avail: Univ. Microfilms Order No. DA9120481

The focus was to determine the accuracy and predictability, and hence the effectiveness, of current practices of indexing geographic concepts for retrieval from online bibliographic files within the domain of earth sciences. The methodology was based on the measurement of geographic similarity between pairs of documents. The geographic study area for each document in a test file of earth science documents was represented in at least three ways: by a map and by the text of bibliographic records from two online bibliographic files. The geographic similarity of the documents to one another was measured spatially using the maps and linguistically using the text, both indexing terminology and free text, under both Boolean and vector retrieval models and with frequency weighting of terms. Correlation analysis of the map-based geographic similarities to the text-based similarities was used to evaluate the effectiveness of geographic representation. Some records also included representation of the geographic concepts with latitude and longitude coordinates which were compared spatially to the map-based representations of the study areas and to the text-based representations. Optimal recall and precision values for three case study areas, using text and coordinates, were also derived, using the overlap of map areas to define the relevant sets. Results indicate only weak correlations between the text-based and the spatially-based geographic representations, related to the imprecise nature of words in representing geographic areas and to the lack of predictability of the terminology used to describe a particular area. Recall and precision values for optimal search strategies for three case studies exhibited a great range of values with average values of 50 percent recall and 41 percent precision. Free text performed better than index terms in both correlation values to map-based geographic similarities and in search strategies; the advantage was based primarily on individual words in the index term phrases.
Dissert. Abstr.

N92-13880 Maryland Univ., College Park.
KNOWLEDGE-BASED SELECTION OF DATABASES: AN ALGORITHM AND ITS EVALUATION Ph.D. Thesis
Xianhua Wang 1990 422 p
Avail: Univ. Microfilms Order No. DA9121448

Database selection, an issue of increasing importance as computerized files proliferate, was addressed. Database guides and selection programs are limited in considering the full range of capabilities of databases. This project designed and tested the effectiveness of a prototype system to select databases for queries in business. The system provides extensive descriptions of 26 business-related databases, using the entity-relationship approach as the conceptual schema. Data were derived from vendor descriptions and business thesauri and dictionaries. The knowledge basis consists of a conceptual schema, a thesaurus, and the database descriptions. The system is implemented in Prolog. No interface was established for end-user searching. An emphasis in evaluation is the effectiveness of the conceptual schema for representing database information. To test the system effectiveness of the conceptual schema for representing database information. To test the system effectiveness, the system's response was compared with databases chosen by professional searchers. Each searcher chose databases for twelve actual reference queries and stated their reasoning. Using search algorithms optimizing recall, the system generated responses for all 24 questions. For each set of questions, databases selected by the system and each searcher were considered relevant. The judge decided the relevance of databases not unanimously chosen. Formative evaluation of the search results, including the searcher's reasoning, provided the basis for determining factors contributing to the success or failure of the prototype. Reasons for failure included, for example, inability to represent specific data, insufficient database descriptions, problems with question interpretation, breadth of searching (algorithm problems). Suggestions for improvement of all components of the system are included in the results. The appendices include the formative analysis for each query, the Prolog program, and individual database descriptions, which reflect the conceptual schema. Dissert. Abstr.

N92-13881*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
ANNOTATED DIRECTORY OF US GOVERNMENT INFORMATION SYSTEM PROJECTS OF POTENTIAL INTEREST TO NASA/SSPO Final Report
Sue LeGrand (Softech, Inc., Houston, TX.) 7 Oct. 1988 26 p
(Contract NCC9-16; RICIS Proj. SE-17)
(NASA-CR-188946; NAS 1.26:188946) Avail: NTIS HC/MF A03 CSCL 05B

The purpose of this research activity was to develop a list for NASA of major U.S. government information systems contacts who are able to cooperate with NASA on technical interchange. The list contains the names of appropriate managers involved in major information system projects, U.S. government office officials, and their hierarchy up to the highest officials whose major responsibilities include government information systems development. Author

N92-13882# General Accounting Office, Washington, DC. Information Management and Technology Div.
ADP SYSTEMS: EEOC'S CHARGE DATA SYSTEM CONTAINS ERRORS BUT SYSTEM SATISFIES USERS. REPORT TO THE CHAIRMAN, SPECIAL COMMITTEE ON AGING, US SENATE
JayEtta Z. Hecker Dec. 1989 26 p
(GAO/IMTEC-90-5; B-233325) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

The General Accounting Office (GAO) was asked to determine whether the Equal Employment Opportunity Commission's (EEOC) Charge Data System (CDS) can provide accurate, complete, and current data to EEOC in its administration and enforcement of the Age Discrimination in Employment Act. CDS is an automated information system used by EEOC to maintain information on discrimination cases, monitor and track its investigating and processing of cases, and prepare management, information, and statistical reports. The Age Discrimination in Employment Act, 29 U.S.C. 621-634, as amended, protects individuals age 40 and over from employment discrimination on the basis of age and also protects capable employees from being forced to retire. EEOC

must investigate and take appropriate action, if necessary, within the time frames specified in the statute of limitations. Failure to do so may result in the employee losing the right to sue in court. Age discrimination information in the CDS databases was tested at 6 EEOC field offices and 2 Fair Employment Practice Agencies. The selection represented a mix of low to high caseload volume and well and not-so-well managed district offices based on EEOC's views, GAO experience, and the preferences of the Committee on Aging. Each office's sample size was determined to produce a sampling error no greater that 10 percent at a 95 percent confidence level. GAO estimated that from 4.1 to 12.6 percent of the CDS mandatory data fields were in error, out-of-date, or missing, but that this did not affect the investigation of individual cases because EEOC investigators do not use CDS to support their investigative work. None of the sample cases had exceeded the statute of limitations. Managers were generally satisfied with CDS. GAO recommended the establishment of an accuracy standard for CDS databases and procedures for ensuring compliance with this standard. J.P.S.

N92-13883# General Accounting Office, Washington, DC. Information Management and Technology Div.
INFORMATION RESOURCES: ARMY CORPORATE DATA BASE DISREGARDS CONGRESSIONAL AND DOD DIRECTION. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON DEFENSE, COMMITTEE ON APPROPRIATIONS, HOUSE OF REPRESENTATIVES
Samuel W. Bowlin Jul. 1990 28 p
(GAO/IMTEC-90-64; B-239633) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

In fiscal year 1988, the Army canceled its Corporate Data Base Project, begun in 1984 to improve the quality of information used to make personnel, equipment, financial, and other decisions, because it could not address congressional and Secretary of Defense questions about mission need and potential economic benefit. The Congress denied the Army's fiscal year 1987 funding request for the project because the Army had not adequately defined requirements, performed a cost/benefit analysis, or determined the total project cost. At the request of the House Subcommittee on Defense, the General Accounting Office (GAO) determined that the Army is continuing to develop an ad hoc corporate database through 8 initiatives at the headquarters, major command, and installation levels and that these initiatives are intended to provide capabilities identical or very similar to the canceled database project. These initiatives are not centrally-directed or in compliance with pertinent Federal and Defense policies, therefore the Army cannot be sure that these systems will meet valid mission needs, will work together and not duplicate one another, or are cost effective. In addition, the cost of development, maintenance, and operation are not known. GAO recommends that the Secretary of Defense direct the Secretary of the Army to suspend development activity on the 8 initiatives GAO identified, not to resume any of them unless all required Federal and Defense acquisition requirements are met, and prohibit funding for any other initiative whose purpose is to achieve a corporate database until the Army justifies to the Secretary of Defense and Congress the need and potential economic benefit of an Army-wide corporate database. J.P.S.

N92-13884# General Accounting Office, Washington, DC. National Security and International Affairs Div.
TRADE AND ECONOMIC DATA: MANY FEDERAL AGENCIES COLLECT AND DISSEMINATE INFORMATION. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON NATIONAL SECURITY ECONOMICS, JOINT ECONOMIC COMMITTEE, US CONGRESS
Allan I. Mendelowitz May 1991 19 p
(GAO-NSIAD-91-173; B-243341) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

The General Accounting Office (GAO) was asked to obtain information on what foreign economic data are available to U.S. businesses and policymakers to assist U.S. businesses in obtaining an appropriate share of foreign markets. GAO identified 17 agencies that collect, maintain, and disseminate foreign trade and economic data held by the Federal government. Seven agencies collect the greatest amount of this information, They are the Departments of Commerce, State, Labor, Energy, and Agriculture; the Federal Reserve System; and the U.S. International Trade Commission. Both statistical data and narrative information on foreign economies and U.S. trade are provided in either published or unpublished form to government officials or academic and business organizations. A centralized dissemination point for this data has been the National Trade Data Bank (NTDB). The Commerce Department established the Bank in August 1990 to be a one-stop source of information on foreign economies and trade as intended by the Omnibus Trade and Competitiveness Act of 1988. GAO identified additional Federal databases not currently included in the NTDB that could make it more useful to its subscribers. NTDB officials agreed that some of the information identified could be of interest to NTDB users and is being considered for addition to the Bank. NTDB is concerned with the additional resources that expanding the Bank will require. It is likely that the NTDB would have to add a second CD-ROM and considerable monthly maintenance to the present system. J.P.S.

N92-13885# General Accounting Office, Washington, DC. Information Management and Technology Div.
SPACE DATA: INFORMATION ON DATA STORAGE TECHNOLOGIES. FACT SHEET FOR THE CHAIRMAN, SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE, COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION, US SENATE
Samuel W. Bowlin Sep. 1990 21 p
(GAO/IMTEC-90-88FS; B-240617) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

This is a report on advanced data storage technologies, including their strengths, weaknesses, and costs. Characteristics and cost information on different media and the drive required to access the data stored in that media were collected from literature searches, manufacturers, NASA personnel, data storage media experts, and an IEEE symposium on mass storage systems. NASA anticipates the volume of data generated and stored will rise in the next decade from 62 terabits (or 63 times 1 trillion bits) of data to more than 66 times that amount - a volume unprecedented in the history of the agency. The characteristics and costs of the various technologies are presented with accompanying illustrations and tables. J.P.S.

N92-13886# Naval Postgraduate School, Monterey, CA.
DESIGN AND IMPLEMENTATION OF A MULTIMEDIA DBMS. RETRIEVAL MANAGEMENT M.S. Thesis
Wuttipong Pongsuwan Sep. 1990 140 p
(AD-A241069) Avail: NTIS HC/MF A07 CSCL 12/7

Current conventional Database Management Systems (DBMS) manage only alphanumeric data. However, data to be stored in the future is expected to include some multimedia form, such as images, graphics, sounds or signals. The structure and the semantics of the media data and the operations on that data are complex. It is not clear what requirements are needed in a DBMS to manage this kind of data. It is also not clear what is needed in the data model to support this kind of data; nor what the user interface should be for such a system. The goal of the Multimedia Database Management System project in the computer science department of the Naval Post Graduate School is to build into a Database Management System (DBMS) the capability to manage multimedia data, as well as the formatted data, and define operations on multimedia data. This thesis, focusing only on the media data of image and sound, first describes the operations of such a system, then discusses the general design of it, and finally outline the detailed design and implementation of the retrieval operation. GRA

N92-13887# Naval Postgraduate School, Monterey, CA.
CONCEPTS HIERARCHIES FOR EXTENSIBLE DATABASES M.S. Thesis
Christopher A. Barnes Sep. 1990 81 p
(AD-A241353) Avail: NTIS HC/MF A05 CSCL 12/7

This thesis presents a simple and efficient method of implementing a semantic type checking system for use with relational databases. Numeric data typically represent measures of a specific property or characteristic of a real world object. Computers manipulate only the numeric value. It is the responsibility of the user to ensure that the data are handled in a manner consistent with its meaning. If the semantics associated with the numbers are stored in a data dictionary, semantic consistency can be verified by the database system. This increases the integrity of data manipulation and helps ensure meaningful results. This thesis demonstrates a simple scheme of representing the property, or quantity, and unit of measure associated with numeric attributes. This information is then used to verify dimensional consistency of database queries and to automatically convert units across systems of measurement. Finally, a concept is defined for each relation in the database. These concepts can be used to build a concept hierarchy to help ensure queries are consistent with the semantics of the database design. GRA

N92-13888# Human Engineering Labs., Aberdeen Proving Ground, MD.
PROCEDURAL TEXT: PREDICTIONS OF IMPORTANCE RATING S AND RECALL BY MODELS OF TEXT COMPREHENSION Final Report
Carol B. Mills, Virginia A. Diehl, Deborah P. Birkmire, and Lien-Chong Mou Aug. 1991 50 p
(AD-A241395; HEL-TM-16-91) Avail: NTIS HC/MF A03 CSCL 05/2

Two models of text comprehension, a process model proposed by Kintsch and van Dijk (1978) and a causal model proposed by Trabasso and Sperry (1985), were tested in two experiments with eight procedural texts. In Experiment 1, 24 female college students rated the importance of propositions, idea units, and sentences to the overall procedure described in the texts on a 7-point scale. In Experiment 2, 16 female college students recalled each of the eight texts immediately after reading it. Predictors derived from the models were used to predict the ratings and the recall in multiple regression analyses. The results showed that the amount of variance accounted for by the predictors varied from text to text. In general, for the ratings and recall, the causal model accounted for more variance than the process model did. For the process model, level within the hierarchy accounted for the most various and for the causal model, the causal chain factor accounted for the most variance. The models were not as powerful as in previous research with narrative texts perhaps because these models do not take into account the cognitive representation involved in doing the task described by a procedural text. GRA

N92-13889# Defense Technical Information Center, Alexandria, VA.
DEFENSE TECHNICAL INFORMATION CENTER (DTIC) CHRONOLOGY OF SELECTED REPORTS, POLICY INSTRUMENTS, AND SIGNIFICANT EVENTS AFFECTING FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION (STI), 1945-1990 Final Report
Anna E. Kramer Sep. 1991 15 p
(AD-A241550; DTIC/TR-91/4) Avail: NTIS HC/MF A03 CSCL 05/2

This technical report is a chronology that highlights the more significant events and achievements relating to DTIC and its role in providing STI from the information sources to the user community, 1945-1990. GRA

N92-13890# Institute for Defense Analyses, Alexandria, VA.
DARPA TECHNICAL ACCOMPLISHMENTS. VOLUME 3: AN OVERALL PERSPECTIVE AND ASSESSMENT OF THE TECHNICAL ACCOMPLISHMENTS OF THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY: 1958-1990 Final Report, Nov. 1990 - Mar. 1991
Richard H. VanAtta, Seymour J. Deitchman, and Sidney G. Reed Jul. 1991 95 p
(Contract MDA903-89-C-0003)
(AD-A241680; IDA-P-2538-Vol-3; IDA/HQ-90-36710-Vol-3; AD-E501436) Avail: NTIS HC/MF A05 CSCL 05/2

IDA has been documenting and assessing the major technical accomplishments and contributions to technological advance made by the Defense Advanced Research Projects Agency (DARPA). Phase 1 (published as Volume 1, P-2192, and Volume 2, P-2429) reviewed the origins, evolution, and impact of 49 projects or program areas. This paper (Phase 2) focuses on the broader context of DARPA's contributions, including influences external to the agency. Its purpose is to describe the motivation for programs undertaken by DARPA, the intrinsic nature of the research, and the technological advances that emerged. Some programs, such as ballistic missile defense and large acoustic arrays for antisubmarine warfare, were highly successful in their own context, while others, such as computing and computer networks, had wider ramifications for national technological developments. The paper also derives lessons for future DARPA strategic planning and project management. GRA

N92-13891# Institute for Defense Analyses, Alexandria, VA.
DARPA TECHNICAL ACCOMPLISHMENTS. VOLUME 2: AN HISTORICAL REVIEW OF SELECTED DARPA PROJECTS Final Report, Jan. 1990 - Mar. 1991
Richard H. VanAtta, Sidney G. Reed, and Seymour J. Deitchman Apr. 1991 411 p
(Contract MDA903-89-C-0003)
(AD-A241725; IDA-P-2429-Vol-2; IDA/HQ-90-36707-Vol-2; AD-E501441) Avail: NTIS HC/MF A18 CSCL 15/6

This is the second of three volumes on the history of DARPA accomplishments and their implications. The first two volumes include histories of selected DARPA projects. The purpose of these histories is to record, for projects and programs having important outputs and for which adequate and appropriate data could be gathered, the chronological and technical histories in such a way that (1) the influence of the projects or programs on defense and civilian technology could be traced, and (2) implementation lessons could be extracted that would help DARPA manage future programs in such a way as to enhance their chances of success. This volume describes program histories of 21 DARPA projects. Each history describes the genesis of the project or program and the major participants and events in its lifetime. Each project review ends with observations about the project's success and the nature of its impact. Volume 2, along with Volume 1, comprises the source material for Volume 3, which analyzes the projects in the broader context of DARPA's history and the influences of the external environment on the agency. GRA

N92-13892# Defense Technical Information Center, Alexandria, VA.
REFERRAL DATABASE DIRECTORY
Carol E. Jacobson and Randy L. Bixby Oct. 1991 611 p Revised
(AD-A241750; DTIC/TR-91/3) Avail: NTIS HC/MF A99 CSCL 05/2

This directory contains a listing of specialized scientific and technical information sources operated or supported by the Department of Defense (DoD) or other Federal agencies. Arrangement is numerical by referral number with three indices: Referral name, Points-of-contact, and Subject. There is also a listing of DoD information analysis centers. Each referral shows pertinent information on its mission, special subject areas, availability of material, etc. GRA

N92-13893# Naval Postgraduate School, Monterey, CA.
THE IMPLEMENTATION OF FORM-BASED INTERFACE FOR RELATIONAL DATABASE M.S. Thesis
Partoyo Dec. 1990 118 p
(AD-A241760) Avail: NTIS HC/MF A06 CSCL 12/7

Currently, the problem with relational DBMS's is a lack of user friendly interface. Relational query languages such as SQL and QUEL are not ideal languages for end users. The forms approach is considered the most natural interface between end-user and database. Several systems based on the forms concept have been designed and implemented. This thesis studies the effectiveness of a form-based visual interface. To evaluate the development process of the form-based applications, this thesis includes the simple implementation of form-based interface using the Form Designer of Superbase-4. GRA

N92-13894# Naval Postgraduate School, Monterey, CA.
DESIGN AND IMPLEMENTATION OF A MULTIMEDIA DBMS: CATALOG MANAGEMENT, TABLE CREATION AND DATA INSERTION M.S. Thesis
Su-Cheng Pei Dec. 1990 199 p
(AD-A241761) Avail: NTIS HC/MF A09 CSCL 12/5

Current Database Management Systems (DBMS) manage only alphanumeric data but not multimedia data. In order to have a DBMS that can handle both alphanumeric data and multimedia data, one can either build a new system or modify an existing system. The decision was to build such a system on top of an existing system, namely INGRES, using the abstract data type (ADT) concept. Unfortunately the INGRES system used does not support ADT. As a result the Multimedia Database Management System (MDBMS) prototype must design data structures that would allow the capture and retrieval of the information relating to the data in the database. Furthermore, to implement the ADT concept for the multimedia data, additional tables need to be created that would hold information relating to the multimedia data. This process of dealing with the management of information, generally referred to as catalog management, in the MDBMS prototype is a major part of this thesis. The design of the data structures and their applications are explained. In addition, to be able to insert data into the database, operations for the creation of tables and the insertion of the data are needed. These operations are not a simple, single SQL statement. Because of the potential presence of multimedia data, the generation of multiple statements may be required from one simple user statement. The thesis also discusses the design and implementation of these operations. GRA

N92-13895# Westinghouse Hanford Co., Richland, WA.
PROGRAM INFORMATION ARCHITECTURE/DOCUMENT HIERARCHY
T. W. Woods Sep. 1991 42 p
(Contract DE-AC06-87RL-10930)
(DE92-000529; WHC-EP-0506) Avail: NTIS HC/MF A03

The Nuclear Waste Management System (NWMS) Management Systems Improvement Strategy (MSIS) requires that the information within the computer program and information management system be ordered into a precedence hierarchy for consistency. Therefore, the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM) requested Westinghouse Hanford Company to develop a plan for NWMS program information which the MSIS calls a document hierarchy. This report provides the results of that effort and describes the management system as a program information architecture. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N92-13896# General Accounting Office, Washington, DC. Accounting and Financial Management Div.
FINANCIAL MANAGEMENT: ACTIONS NEEDED TO ENSURE EFFECTIVE IMPLEMENTATION OF NASA'S ACCOUNTING SYSTEM. REPORT TO THE ADMINISTRATOR OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Aug. 1991 29 p
(GAO/AFMD-91-74; B-243962) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

This report provides the General Accounting Office's (GAO) review of the National Aeronautics and Space Administration's (NASA) efforts to design and develop the NASA Accounting and Financial Information System (NAFIS). NAFIS is planned to standardize NASA's accounting systems at Headquarters and its nine field Centers. If properly implemented, NAFIS could provide NASA with a significant improvement over the costly, outdated, and nonintegrated accounting and financial reporting systems currently in place. However, the GAO finds that NASA's planning for the NAFIS project does not identify all systems development costs, milestones, and related system interfaces, and that NASA has not adequately performed all analyses or finalized and approved a project plan to guide systems development, conversion, and implementation. GAO states that because of this, NAFIS will cost significantly more and take longer to fully implement than currently planned and will not meet the Office of Management and Budget's (OMB) mandate for an integrated financial management system. GAO recommends that: (1) the Comptroller be directed to ensure that the agency's 5-year financial systems plan discloses all project costs and milestones for developing and implementing NAFIS and NAFIS interfaces, as well as NASA's plans to standardize its planning and budget systems and integrate or interface them with NAFIS to achieve a single, integrated financial management system; (2) the approved plan be implemented; and (3) the NASA Office of the Inspector General upgrade its expertise as needed to provide oversight for the plan and its implementation. J.P.S.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-13897*# National Aeronautics and Space Administration, Washington, DC.
SPINOFF, 1991
1991 145 p Original contains color illustrations
(NASA-NP-147; NAS 1.83:147; ISBN-0-16-035821-3) Avail: NTIS HC/MF A07; 139 functional color pages CSCL 05B

This is an instrument of the Technology Utilization Program

and is designed to heighten awareness of the technology available for transfer and its potential for public benefit. NASA's mainline programs, whose objectives require development of new technology and therefore expand the bank of technology available for transfer in future years, are summarized. Focus is on the representative sampling of spinoffs (spinoff, in this context, means products and processes developed as secondary applications of existing NASA technology) that resulted from NASA's mainline programs. The various mechanisms NASA employs to stimulate technology transfer are described and contact sources are listed in the appendix for further information about the Technology Utilization Program. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-13898 Manchester Univ. (England).
OPTICAL OBSERVATIONS OF GALACTIC GASEOUS NEBULAE WITH HIGH-SPEED IONISED FLOWS Ph.D. Thesis
M. J. Whitehead 1989 313 p
Avail: Univ. Microfilms Order No. BRD-902551

The dynamics of seven galactic objects that cover four distinct classes of ionized gaseous nebulae have been studied in the optical domain. All exhibit interesting (and some unusual high-speed) internal motions. Emission-line profiles have been obtained at both high spectral and spatial resolution with the Manchester echelle spectrometers combined with either the Herschel, Newton or Anglo-Australian telescopes. Direct imagery and both low and intermediate dispersion spectra is presented for several of the objects under study. Data is presented for M16-HH1. The bright knot shows high velocities and appears to be positioned at the edge of an expanding ionization front. The knot is part of a more extended structure that is comprised of filaments that are moving at lower velocities. MZ3 appears to be in the proto-planetary stage in the formation of a Type 1 planetary nebula. From the central core, which is both He and N rich, direct starlight is detected, and this core also exhibits very complex motions. Multiple shell ejection would seem to have occurred. For both NGC 2346 and M3-28 only one shell ejection is indicated, and both these nebulae exhibit regular motions and reveal no particularly high-speed flows in their cores or lobes, and would seem to be at later stages in the formation of planetary nebulae. RCW 104 is shown to have a dumb-bell shaped appearance in which the central star is positioned asymmetrically. Knots of high-speed gas have been discovered which occur over the filamentary edge. No similar knots are found in NGC 3199, although again radiative ionization is apparent. This nebulae appears as a faint outer shell that forms an ellipse and the location of the exciting star suggests substantial stellar displacement has taken place. The compact core of the peculiar SNR CTB 80 appears to consist of four shell-like structures at H alpha. Ionization by shocks of shells with different velocities is implied. Dissert. Abstr.

N92-13899*# Laser Power Research, San Diego, CA.
DIGITAL IMAGE PROFILERS FOR DETECTING FAINT SOURCES WHICH HAVE BRIGHT COMPANIONS, PHASE 2 Quarterly Report
Elena Morris and Graham Flint 7 Nov. 1991 26 p
(Contract NAS7-1103)
(NASA-CR-189459; NAS 1.26:189459) Avail: NTIS HC/MF A03 CSCL 03A

A breadboard image profiling system developed for the first phase of this project demonstrated the potential for detecting extremely faint optical sources in the presence of light companions. Experimental data derived from laboratory testing of the device supports the theory that image profilers of this type may approach the theoretical limit imposed by photon statistics. The objective of Phase 2 of this program is the development of a ground-based multichannel image profiling system capable of detecting faint stellar objects slightly displaced from brighter stars. We have finalized the multichannel image profiling system and attempted three field tests. Author

N92-13107*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
HUBBLE SPACE TELESCOPE (HST): EMERGENCY SUPPORT
J. Repass (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) and F. Wojtalik *In* JPL, California Inst. of Tech., Deep Space Network: Mission Support Requirements Oct. 1991 4 p (For primary document see N92-13088 04-12)
Avail: NTIS HC/MF A10 CSCL 03A

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

N92-13900 Oxford Univ. (England).
LEAD IN THE EARLY SOLAR SYSTEM Ph.D. Thesis
John Walter Arden 1989 356 p
Avail: Univ. Microfilms Order No. BRD-92615

The hypothesis of heterogeneity in the isotopic composition of primordial lead is the principal subject. Experimental evidence from the Allende carbonaceous chondrite demonstrates that this heterogeneity is not attributable to a post-4.55 Gy addition, to a homogeneous initial composition, of radiogenic isotopes unsupported by their parent nuclei. Computed primordial lead isotopic compositions in meteorites define linear arrays in three-isotope diagrams in which the two end-member compositions may have their origins in the r- and s-processes, respectively. The linear arrays place constraints on the isotopic composition of lead produced in these nucleosynthetic processes, which subsequently evolved to form a primordial composition. For a single r-process event, a possible range of primordial lead isotopic compositions is computed. The least radiogenic lead found in the type IA iron meteorites is considered to represent the isotopic composition of s-process lead. Radiogenic lead evolves on primordial compositions which lie on a linear r-s mixing line. The resultant compositions are dependent on the relative contributions and isotopic composition of the two components and are not uniquely defined by the radiogenic lead in the sample. Apparent scatter in isochron ages and low model ages of phases formed at 4.55 Gy are to be expected, if the proportions of these two components differ within each sample. Heterogeneity in primordial lead is expected and should have persisted in primitive meteorites through the processes of accretion and parent body formation. As isotopic homogenization of all the r- and s-process lead isotopes, which contribute to the primordial composition, did not occur at the onset of a specific time interval, the criteria for U-Th-Pb and Pb-Pb chronology are not fulfilled. Dissert. Abstr.

N92-13901 Pittsburgh Univ., PA.
STUDIES OF ANTARCTIC METEORITES: A STATISTICAL COMPARISON OF ANTARCTIC FINDS AND NON-ANTARCTIC FALLS; AND THE ORIGIN AND SIGNIFICANCE OF COSMIC DUST FROM THE WALCOTT NEVE, ANTARCTICA Ph.D. Thesis
Ralph P. Harvey 1990 122 p
Avail: Univ. Microfilms Order No. DA9120133

The masses and numbers of meteorites in four meteorite samples (the modern falls (MF), Antarctic finds (AF), Yamato fins

(YAM), and Allan Hills Main icefield finds (ALH)) are compared. The mass frequency distributions and the proportions of different classes of meteorites differ between AF and MF. Several well known distributions, when compared to the samples, give varying degrees of fit. When Antarctic post-fall processing is empirically corrected for, the proportions of different types converge for the AF and MF samples. There is an excess in numbers of small H chondrites in the AF sample relative to the MF sample which cannot be corrected for in this manner. In four of six sediment samples returned from locations around the Walcott Neve area of Antarctica, a high concentration of ablation spherules was found, averaging roughly 20 spherules per g bulk sediment. These concentrations have an origin similar to that of Antarctic meteorites; strong katabatic winds cause cosmic dust ablating out of blue ice to be transported downwind and downslope to the nearest aeolian sediment trap. In the Walcott Neve, these traps are the crests or moraines, weathering debris around boulders and rough, exposed areas. Their content of ablation spherules is similar to Greenland and Cap Prudhomme sediments, with the exception of a slightly higher proportion of high-Mg glassy spheres, a large number of greater than 500 micron sized spherules, and a few extremely large minimeteorites from a firn sample. Most of the spherules are essentially unweathered; however, a great range in weathering is also observed. Only a small number of unmelted micrometeorites were found by comparison to the Greenland and Cap Prudhomme sediments. They may truly be mission, or may be camouflaged by local terrestrial debris. Author

N92-13902 Maryland Univ., College Park.
ABSORPTION AND SCATTERING PROPERTIES OF IRREGULARLY SHAPED, INHOMOGENEOUS PARTICLES Ph.D. Thesis
David Bazell 1990 191 p
Avail: Univ. Microfilms Order No. DA9121314

The infrared absorption and scattering properties of small particles are explored using a technique that treats particles as being composed of numerous individual electric dipole moments. This Discrete Dipole Approximation is developed theoretically, along with a model for the formation of irregularly shaped particles that are characterized by a fractal dimension. By independently assigning a different composition to each dipole moment in the particle, compositional effects are introduced into the problem. It is shown that particle shape and composition have significant effects on the magnitude and shape of absorption features in the infrared. In the context of infrared absorption, the use of the Maxwell-Garnett and Bruggeman effective medium theories for averaging dielectric constants is examined. It is concluded that neither technique yields very good results when used in the examination of absorption in inhomogeneous small particles. The magnitude of the differential scattering cross section as a function of angle is also strongly affected by the shape and composition of the scattering particles. The albedo is very dependent of the particle composition, but only has a weak shape dependence. Conversely, the average cosine of the scattering angle is mainly dependent on the particle shape, with only a weak composition dependence. These two observational quantities can in principle be used to distinguish shape and composition effects in astrophysical situations. Comparisons are made between models consisting spherical or fractal grains of different compositions and observations of important infrared features including the 3 micron H2O ice feature and the 9.7 and 18 micron silicate features. The results indicate that better agreement is generally obtained using fractal grain models than is obtained with models that use spherical particles. Dissert. Abstr.

N92-13903 California Univ., Santa Cruz.
THE POLARIZATION CHARACTERISTICS OF SEYFERT 2 GALAXIES Ph.D. Thesis
Laura Ellen Kay 1990 122 p
Avail: Univ. Microfilms Order No. DA9119305

It is suggested that at least some Seyfert 2s are Seyfert 1s where the direct view of the central nuclear region is blocked by a thick disk or torus, so that it can be seen only in light scattered above or below the disk. The polarization was studied of the featureless continua radiation of Seyfert 2 galaxies in order to determine if this model can be generalized. If this radiation is observable only by scattering then it is expected to be polarized; if it is not polarized, then it may be seen directly, which would go against this unified Seyfert model. A sample of 50 Seyfert 2 galaxies was studied in the wavelength range 3200 to 6400 A using the CCD spectropolarimeter with the UV Schmidt camera at the Lick 3-meter telescope. Observations were made as far to the blue as possible, since the featureless continuum radiation is less likely to be highly contaminated there by the starlight dominating most Seyfert 2 spectra. The stellar absorption line spectrum was carefully removed so that the undiluted polarization of the isolated nuclear radiation could be analyzed. All of the Seyfert 2 galaxies had a nonstellar component to their spectrum. The polarized flux spectrum of Mrk 266 SW showed a broadened H beta, suggesting a hidden BLR. For most of the other polarized objects, the data were consistent with an interstellar origin for the polarization; some of these should be re-observed at the stronger emission at H alpha. Thus it seems unlikely that the 2 types of Seyferts differ only by the aspect angle; there are probably variations in the geometry of the obscuration region and in some physical parameters. Dissert. Abstr.

N92-13904# Los Alamos National Lab., NM.
ON ADAPTIVE GRID COMPUTATIONS OF VARIABLE STARS
A. N. Cox, R. G. Deupree, and M. Gehmeyr 1991 41 p Presented at the 11th Annual Center for Nonlinear Studies (CNLS) Conference, Los Alamos, NM, 20-24 May 1991
(Contract W-7405-eng-36)
(DE92-000221; LA-UR-91-2963; CONF-9105252-2) Avail: NTIS HC/MF A03

We show that the use of an implicit adaptive-grid technique is an efficient and up-to-date approach for the calculations of radial oscillations in variable stars. We chose as an illustrative example the radiative envelope of an RR Lyrae variable. For the hydrostatic initial model we compare the Lagrangean ratioed zoning with an adaptive-grid rezoning. We show that the adaptive-grid yields an optimal distribution of the mesh points in the sense that the relevant physical features, the H- and He 1-, He 2-ionization zones, are well resolved. For the hydrodynamical evolution we present the full-amplitude model for both the Lagrangean and adaptive-grid computations. We perform a detailed comparison and show that the adaptive-grid method yields limit cycle solutions that are substantially improved over the Lagrangean grid model. This is due to the fact that the Lagrangean mesh sweeps through the ionization zones twice during one oscillation period, whereas the adaptive-mesh resolves them and tracks them continuously. The results are, in particular, smooth radial velocity and light curves. Beyond a physically better defined solution we also observe larger time steps for the convergence towards the limit cycle and for the evolution during one period. DOE

N92-13905# Air Force Academy, CO.
REPRESENTING THE NOMINAL PATH FOR AN INTERIOR LIBRATION POINT ORBIT IN THE SUN-EARTH+MOON ELLIPTIC RESTRICTED THREE-BODY PROBLEM Final Report
Steven C. Gordon 7 Sep. 1991 67 p
(AD-A241396; USAFA-TR-91-11) Avail: NTIS HC/MF A04
CSCL 03/3

Bounded nominal paths can be constructed in the vicinity of the interior equilibrium point (sometimes called a libration or Lagrange point) for the Sun-Earth+Moon Elliptic Restricted Three-Body Problem. Numerical integration is used to generate the periodic or quasi-periodic reference trajectories in this effort. The output of the routine will be numerical values for each of the six states (three position and three velocity) at each of the integration time steps. Linearization of both the equations of motion and of the equations representing the tracking solution assumes access to a continuous representation of the spacecraft's orbit. Follow-on research that investigates tracking errors or station-keeping costs may also need a continuous (and smooth) representation of the six states or, at least, may need access to

an interpolation routine. Consequently, this work explores the generation of curves through the numerical data representing the libration point orbits in the Sun-Earth+Moon ER3BP; these orbits are computed in the vicinity of the interior libration point between the Sun and the Earth+Moon barycenter. GRA

N92-13906# Panametrics, Inc., Waltham, MA.
DEVELOPMENT AND USE OF DATA ANALYSIS PROCEDURES FOR THE CRRES PAYLOADS AFGL-701-2/DOSIMETER AND AFGL-701-4/FLUXMETER AND APPLICATION OF THE DATA ANALYSIS RESULTS TO IMPROVE THE STATIC AND DYNAMIC MODELS OF THE EARTH'S RADIATION BELTS
Bronislaw K. Dichter and Frederick A. Hanser 26 Jul. 1991 29 p
(Contract F19628-87-C-0169)
(AD-A241399; PL-TR-91-2186; SR-3) Avail: NTIS HC/MF A03 CSCL 03/2

Results of a calibration of a spacecraft instrument for measuring fluxes of high energy electrons (1 to 10 MeV) in the Earth's radiation belts are presented. Experimental results are supplemented by Monte Carlo calculations of electron transmission and energy deposition in the instrument sensors. GRA

N92-13907# International Centre for Theoretical Physics, Trieste (Italy).
THE EFFECT OF TEMPERATURE AND THE SPIN EXCESS PARAMETER ON NEUTRON STARS STRUCTURE
M. Abd-Alla, M. Y. M. Hassan, and H. S. Ragab (Cairo Univ., Egypt) Oct. 1990 12 p
(DE91-634395; IC-90/369) Avail: NTIS HC/MF A03

A previous equation of state, deduced for thermal neutron matter with spin excess neutrons, is used to explore the effect of temperature and spin excess parameter on neutron star structure. The spin excess parameter is found to have a significant decreasing effect on the maximum mass of neutron stars, while it has an increasing effect on the central density of stable neutron stars. The behavior of neutron star radius, for stars with central density less than three times normal nuclear matter density, depends on the spin excess parameter in a significant way. For stars having larger central density the spin excess parameter has little decreasing effect on the star radius. The temperature is found to have little increasing effect on both the star mass and its radius. The equation of state used is very stiff, but the resulting maximum masses lie within the range of neutron stars masses deduced from X-ray binaries. DOE

N92-13908# International Centre for Theoretical Physics, Trieste (Italy).
THE ROSSELAND MEAN OPACITY OF INTERSTELLAR GRAIN
A. Ali, M. A. ElShalaby (Cairo Univ., Egypt), and M. S. El-Nawawy Oct. 1990 14 p
(DE91-634413; IC-90/283) Avail: NTIS HC/MF A03

We have calculated the opacity of interstellar grains in the temperature range 10 K to 1500 K. Two composite grain models have been considered. One of them consists of silicate coated with ice mantle and the second has a graphite core coated also with ice mantle. These models are compared with isolated grain models. An exact analytical and computational development of Guettler's formulae for composite grain models has been used to calculate the extinction coefficient. It has been found that the thickness of the mantle affects the opacity of the interstellar grains. The opacity of composite models differs from that of the isolated models. The effect of the different species (ice, silicate and graphite) is also clear. DOE

N92-13909# International Centre for Theoretical Physics, Trieste (Italy).
ON THE ORIGIN OF OPTICAL MICROVARIABILITY AND X RAY FLICKERING IN ACTIVE GALACTIC NUCLEI
S. K. Chakrabarti and P. J. Wiita (Georgia State Univ., Atlanta.) Dec. 1990 5 p
(DE91-634414; IC-90/476) Avail: NTIS HC/MF A01

We suggest that non-stationary spiral shocks can produce X-ray flickering and optical microvariability. We show this by detailed non-axisymmetric numerical simulation of accretion disks in a binary system. We show that non-axisymmetric features appear and disappear in time scales of order of few local orbital periods near the inner edge of the disk and shorter than the orbital periods at a large distance. The former type may explain the X-ray flickering and the later type, the optical microvariability. DOE

N92-13661*# California Univ., San Diego, La Jolla. Dept. of Chemistry.
THE RELATIVE IMPORTANCE OF PREBIOTIC SYNTHESIS ON THE EARTH AND INPUT FROM COMETS AND METEORITES Abstract Only
S. L. Miller *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 105 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

N92-13670*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LABORATORY SIMULATION OF THE PHOTOPROCESSING AND WARM-UP OF COMETARY AND PRE-COMETARY ICES: PRODUCTION OF COMPLEX ORGANIC MOLECULES Abstract Only
W. A. Schutte, L. J. Allamandola, and S. A. Sanford *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 116 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-13910*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
POWER MANAGEMENT AND DISTRIBUTION CONSIDERATIONS FOR A LUNAR BASE
Barbara H. Kenny and Anthony S. Coleman (Sverdrup Technology, Inc., Brook Park, OH.) 1991 9 p Proposed for presentation at the Ninth Symposium on Space Nuclear Power Systems, Albuquerque, NM, 12-16 Jan. 1992, sponsored by the Univ. of New Mexico
(NASA-TM-105342; E-6710; NAS 1.15:105342) Avail: NTIS HC/MF A02 CSCL 03B

Design philosophies and technology needs for the power management and distribution (PMAD) portion of a lunar base power system are discussed. A process is described whereby mission planners may proceed from a knowledge of the PMAD functions and mission performance requirements to a definition of design options and technology needs. Current research efforts at the NASA LRC to meet the PMAD system needs for a Lunar base are described. Based on the requirements, the lunar base PMAD is seen as best being accomplished by a utility like system, although with some additional demands including autonomous operation and scheduling and accurate, predictive modeling during the design process. Author

N92-13911*# Southwest Research Inst., San Antonio, TX.
BREMSSTRAHLUNG X RAYS FROM JOVIAN AURORAL ELECTRONS Final Report
J. Hunter Waite, Jr. 1 Sep. 1991 13 p
(Grants NAG5-1429; NAGw-1657; SwRI Proj. 15-3123-028)
(NASA-CR-189493; NAS 1.26:189493) Avail: NTIS HC/MF A03 CSCL 03B

In a recent paper by D. D. Barbosa, it is argued that electron bremsstrahlung is the most likely source of the auroral x-ray emissions that have been observed at Jupiter. Barbosa bases his argument on observational and theoretical studies of the production

of secondary electrons in the Earth's aurora. It is argued here that Barbosa's interpretation is flawed because it ignors the constraint that the primary electron distribution parameters place on the parameters for the secondary electron distribution. As a result, Barbosa's postulated secondary electron fluxes are over three orders of magnitude greater than the theory of auroral electrons permits. Author

N92-13912# Army Construction Engineering Research Lab., Champaign, IL.
OPERATIONS ANALYSIS FOR LUNAR SURFACE CONSTRUCTION: RESULTS OF TWO OFFICE OF EXPLORATION CASE STUDIES Final Report
Lisa Y. Bell, Walter Boles, and Alvin Smith Aug. 1991 78 p (AD-A241643; CERL-TR-M-91/21) Avail: NTIS HC/MF A05 CSCL 22/1

In an environment of intense competition for Federal funding, the U.S. space research community is responsible for developing a feasible, cost-effective approach to establishing a surface base on the moon to fulfill long-term Government objectives. This report presents the results of a construction operations analysis of two lunar scenarios provided by the National Aeronautics and Space Administration (NASA). Activities necessary to install the lunar base surface elements are defined and scheduled, based on the productivities and availability of the base resources allocated to the projects depicted in each scenario. The only construction project in which the required project milestones were not completed within the nominal timeframe was the initial startup phase of NASA's FY89 Lunar Evolution Case Study (LECS), primarily because this scenario did not include any Earth-based telerobotic site preparation before the arrival of the first crew. The other scenario analyzed. Reference Mission A from NASA's 90-Day Study of the Human Exploration of the Moon and Mars, did use telerobotic site preparation before the manned phase of the base construction. Details of the analysis for LECS are provided, including spreadsheets indicating quantities of work and Gantt charts depicting the general schedule for the work. This level of detail is not presented for the scenario based on the 90-Day Study because many of the projects include the same (or similar) surface elements and facilities. GRA

N92-13655*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PLANETARY PROTECTION ISSUES AND HUMAN EXPLORATION OF MARS Abstract Only
D. L. DeVincenzi *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 99 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

N92-13656*# Massachusetts Univ., Amherst.
ANALYSIS OF IMAGES OBTAINED BY THE PHOBOS 2 SPACECRAFT Abstract Only
W. M. Irvine *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 100 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

N92-13657*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TITAN AEROSOL AND GAS EXPERIMENT FOR THE HUYGENS PROBE Abstract Only
G. C. Carle, D. R. Kojiro, V. Oberbeck, B. J. OHara, J. B. Pollack, J. R. Valentin, A. Bar-Nun, M. J. Cohen, J. P. Ferris, and J. M. Greenberg (Leiden Univ., Netherlands) et al *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 101 Prepared in cooperation with State Univ. of New York, Stony Brook (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

N92-13658*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANALYSIS OF MODEL TITAN ATMOSPHERIC COMPONENTS USING ION MOBILITY SPECTROMETRY Abstract Only
D. R. Kojiro, M. J. Cohen, R. F. Wernlund, R. M. Stimac, D. E. Humphry, and N. Takeuchi (TMA/Norcal, Richmond, CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 102 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

N92-13659*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A SILICONE COLUMN FOR GC ANALYSIS OF POLAR AND NONPOLAR CHEMICALS Abstract Only
T. C. Shen *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life Oct. 1991 p 103 (For primary document see N92-13588 04-55)
Avail: NTIS HC/MF A07 CSCL 03B

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N92-13913# Los Alamos National Lab., NM.
MAGNETIC TOPOLOGY OF CORONAL MASS EJECTIONS BASED ON ISEE-3 OBSERVATIONS OF BIDIRECTIONAL ELECTRON FLUXES AT 1 AU
J. L. Phillips, J. T. Gosling, D. J. McComas, S. J. Bame, and W. C. Feldman 1991 7 p Presented at the Solar Connection With Transient Interplanetary Processes (SOLTIP), Castle Liblice (Czechoslovakia), 30 Sep. - 5 Oct. 1991
(Contract W-7405-eng-36)
(DE92-000250; LA-UR-91-2945; CONF-9109254-2) Avail: NTIS HC/MF A02

The solar wind electron heat flux is carried primarily by superthermal halo electrons with energies at 1 AU of approximately 80 eV and greater. These halo electrons typically are beamed antisunward along the IMF, indicating effective magnetic connection to the Sun only in one direction. However, ISEE-3 electron observations at 1 AU show that counterstreaming halo beams, suggesting closed magnetic structures, prevail within CMEs. These structures might be magnetic tongues, tied to the Sun at both ends, magnetically detached plasmoids, or perhaps complex flux rope structures. We present the results of analysis of ISEE-3 electron observations within 39 CME's. Parameters analyzed include: the asymmetry between the counterstreaming beams, control by the IMF orientation, and the variation of the electron distributions as a particular CME convects past the spacecraft. We find that some CME's contain nearly symmetric electron beams, while others are strongly asymmetric, and that beam propagating most nearly antisunward is generally dominant. The more nearly radial the IMF the greater is the symmetry between outward and inward beams. Trends observed as CME's propagate past the spacecraft probably result primarily from the compression of the leading edge. We present examples of a previously unreported strahl-on-strahl distribution, suggesting continued magnetic connection to the corona, in which a narrow antisunward beam is superimposed on a broader beam. Preliminary results show that such spectra are present in a substantial fraction of the observed CME's. Taken as a whole, our results appear to favor a tongue or flux rope scenario rather than a detached plasmoid. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

No abstracts in this category.

99 GENERAL

N92-13914# National Technical Information Service, Springfield, VA.

CATALOG OF GOVERNMENT INVENTIONS AVAILABLE FOR LICENSING, 1990

Jan. 1991 251 p

(PB91-100206; ISBN-0-934213-30-5) Avail: NTIS HC/MF A12 CSCL 05B

This catalog provides summaries of more than 900 government inventions. Each summary describes the purpose and the details of the invention. The patents are indexed by both subject and inventor, and listed chronologically under 21 subject areas divided into 48 categories. The main topics covered are agriculture and food; chemistry; combustion and engines; communications; couplings, fitting, and fasteners; computers; detection; electrotechnology; energy; hydraulic and pneumatic equipment; instrumentation and test equipment; machinery and tools; manufacturing and industrial engineering; marine technology; materials; medicine, biology, and human factors; mining; navigation and guidance; photography, and recording devices; physics; and transportation. J.P.S.

N92-13915# National Technical Information Service, Springfield, VA.

FEDERAL LABORATORY TECHNOLOGY CATALOG, 1990: A GUIDE TO NEW AND PRACTICAL TECHNOLOGIES

Mar. 1991 387 p

(PB91-100196; ISBN-0-934213-31-3; ISSN-0886-7836) Avail: NTIS HC/MF A17 CSCL 05B

The catalog presents summaries of practical technology selected for commercial potential and/or promising applications to the fields of computer technology, electrotechnology, energy, engineering, life sciences, machinery and tools, manufacturing, materials, physical sciences, and testing and instrumentation. Each summary not only describes a technology, but also gives a source for further information. Described are some 1,100 new processes, inventions, equipment, software, and techniques developed by and for dozens of Federal agencies during 1990. Coverage includes NASA Tech Briefs as well as fact sheets from other government agencies.. J.P.S.

N92-13916# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

AGARD HIGHLIGHTS 91/2

Sep. 1991 38 p

(ISBN-92-835-0634-0) Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Highlights of the activities of the Advisory Group for Aerospace Research and Development (AGARD) for 1991-92 are given. Topics covered include synthetic aperture radar (SAR), data processing, systems engineering and management, target acquisition, ground support equipment, electronic warfare, space-based radar, European air traffic control, and the research activities of the von Karman Institute. Author

N92-13917 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).

KEMA SCIENTIFIC AND TECHNICAL REPORTS, VOLUME 7, NUMBER 6

A. J. vanLoon, ed. Dec. 1989 104 p

(ISSN-0167-8590; ETN-91-90310) Copyright Avail: N.V. Kema, P.O. Box 9035, 6800 ET Arnhem, Netherlands

Eight papers with the following titles are presented: vented watertrees, oxidation and hydrophilic behavior; microstructural characterization of materials by analytical scanning electron microscopy; discharge parameters in flue gas; software package for the performance of transient simulations of a generator coupled with the public power supply system, DIANE; simple determination of the atmospheric stability class for application in dispersion modeling, using wind fluctuations; electrochemical screening of several alloys for use in a flue gas desulphurization prescrubber; field test for the determination of the magnetizing characteristics of three phase transformers; annual report on Kema research and development for 1988. For individual titles, see N92-13918 through N92-13925.

N92-13918 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Physical Research Dept.

VENTED WATERTREES: OXIDATION AND HYDROPHILIC BEHAVIOUR **c27**

R. Ross, W. S. M. Geurts, J. J. Smit, J. H. vanderMaas, and E. T. G. Lutz (Utrecht State Univ., Netherlands) *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 357-364 (For primary document see N92-13917 04-99)

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It was concluded from Fourier transform microspectrometry and additional experiments that the hydrophilic nature of watertrees is caused by the presence of ionic (end) groups. There are strong indications that an (as yet unknown) oxidation process is occurring during watertree growth. The oxidation stabilities of watertrees and the surrounding crosslinked polyethene are compared. ESA

N92-13919 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Chemical Research.

MICROSTRUCTURAL CHARACTERISATION OF MATERIALS BY ANALYTICAL SCANNING ELECTRON MICROSCOPY **c25**

H. P. A. M. vanderStaak *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 365-376 (For primary document see N92-13917 04-99)

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Scanning electron microscopy combined with wavelength and energy dispersive X ray spectrometry yields an efficient microanalytical technique called Analytical Scanning Electron Microscopy (ASEM). In this technique, the electron beam of a scanning electron microscope interacts with a solid specimen surface. Qualitative and quantitative chemical analysis is based in the information from the X rays emitted. In practice, microscopic areas of inhomogeneous solid samples are imaged using the backscattered electron signal. Positions selected in this image are then analyzed in the X ray mode. With examples typical of work done for chemical research (fly ash, insulating brick, varistors and glass), the applicability of ASEM to materials research is proven. ESA

N92-13920 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Physical Research Dept.

DISCHARGE PARAMETERS IN FLUE GAS **c25**

H. F. A. Verhaart *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 377-383 (For primary document see N92-13917 04-99)

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The discharge parameters for flue gas were determined experimentally according to the electrical or time resolved Townsend's method. Knowledge of these parameters is necessary to describe corona discharges in electrostatic precipitators of coal

fired power plants. Because only computer values of the discharge parameters of flue gas had been available up to now, these experiments increased the understanding of the discharge processes. It was found during the experiments that the attachment coefficient in particular was lower than predicted. ESA

N92-13921 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Electrical Research Dept.
SOFTWARE PACKAGE FOR THE PERFORMANCE OF TRANSIENT SIMULATIONS OF A GENERATOR COUPLED WITH THE PUBLIC POWER-SUPPLY SYSTEM: DIANE **c33**
P. M. vanOirsouw and M. E. Kwakkel *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 385-390 (For primary document see N92-13917 04-99)
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DIANE (Digital Integral Analysis of Network Equations) is a menu driven computer program for making transient calculations of a synchronous generator that is coupled with the public power supply system. These calculations are transient simulations and calculations of the critical clearing time. The development of the program is described, followed by the software requirements. One of the requirements for the program is that it can be run on any MS DOS compatible personal computer. The configuration for which calculations can be performed and the choice of machine and regulator models are explained. The main program functions are illustrated with a number of video display output presentations. ESA

N92-13922 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Environmental Research Dept.
SIMPLE DETERMINATION OF THE ATMOSPHERIC STABILITY CLASS FOR APPLICATION IN DISPERSION MODELLING, USING WIND FLUCTUATIONS **c47**
J. J. Erbrink *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 391-399 (For primary document see N92-13917 04-99)
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A practical and low cost method is proposed for the determination of the atmospheric stability class. The method is based on measurements of the intensity and the time scale of horizontal fluctuations of the wind direction (sigma v and Te respectively) after removal of slow changes in wind direction that are not a result of stability dependent processes. Values of sigma y and sigma z can be calculated directly from the Taylor formula. The input parameters for the model (sigma v and Te) were calculated from measurements at the standard height of 10 m. Given these calculated sigma z values and assuming the validity of the Pasquill dispersion curves for flat terrain, the stability classes can be derived for each hour. The model of sigma y and sigma z was evaluated with a series of lidar and SF6 measurements and appeared to be superior over the traditional method for determination of the stability class. There are no restrictions to the application of the method except under conditions of light wind without a clear wind direction, so that sigma v cannot be defined. The application of this method leads to a more realistic frequency distribution of the stability classes in which the neutral class, D, no longer dominates. ESA

N92-13923 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Chemical Research.
ELECTROCHEMICAL SCREENING OF SEVERAL ALLOYS FOR USE IN A FLUE-GAS DESULPHURISATION PRESCRUBBER **c25**
L. M. Butter, E. J. A. Vogelaar, and W. M. M. Huijbregts *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 401-408 (For primary document see N92-13917 04-99)
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The spray nozzle fasteners in the prescrubber of a flue glass desulphurization plant were damaged by corrosion: the materials used, stainless steel and later titanium, had corroded in the acidic scrubbing water. The behavior of stainless steels, nickel alloys and titanium, which can be applied for the nozzles, was studied by means of electrochemical measurements in a laboratory measuring cell. The measurments showed that corrosive conditions, most stainless steels exhibit pitting and crevice corrosion. Some nickel alloys, especially Hastelloy C22, appear more suitable for use. The measurements also showed that the TiO2 layer dissolves at pH 0.7 under reducing conditions. Titanium also corrodes severely at pH less than 0.7 under oxidizing conditions. The laboratory measurements were consistent with the field test results for most materials. ESA

N92-13924 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Electrochemical Research.
FIELD TESTS FOR DETERMINATION OF THE MAGNETISING CHARACTERISTICS OF THREE-PHASE TRANSFORMERS **c33**
C. G. A. Koreman *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 409-422 (For primary document see N92-13917 04-99)
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A method to determine the magnetizing characteristics of three phase transformers is described. Currents are measured and the voltages generated during transformer switching are used for analysis. The current flowing through the delta winding is calculated from the primary currents instead of derived from measurements. ESA

N92-13925 Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).
[RESEARCH ACTIVITIES AT THE KEMA R AND D FOR 1988] Annual Report **c33**
W. Nagel *In its* KEMA Scientific and Technical Reports, Volume 7, Number 6 Dec. 1989 p 423-459 (For primary document see N92-13917 04-99)
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A summary of the Kema Research and Development (R & D) performed in 1988 is presented. The main objective is to give a general impression of the progress in comparison to the state of the art one year earlier. The projects described here are grouped according to the more general framework of the 1988 Kema R & D; this implies that the following programs are presented: generation with fossil fuels, nuclear energy, environmental research, transmission, distribution and consumption, new generating systems/economy, and measurements and diagnostics. ESA